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Journal

of the association for physical and mental rehabilitation

CORRECTIVE THERAPY

JULY—AUGUST, 1958

VOL. 12, NO. 4

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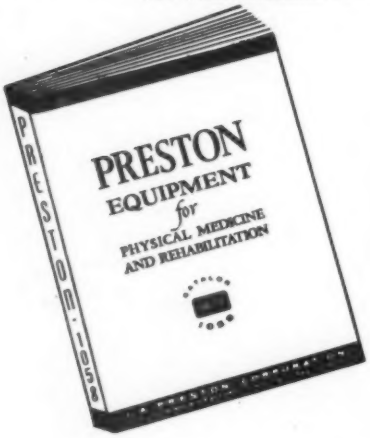

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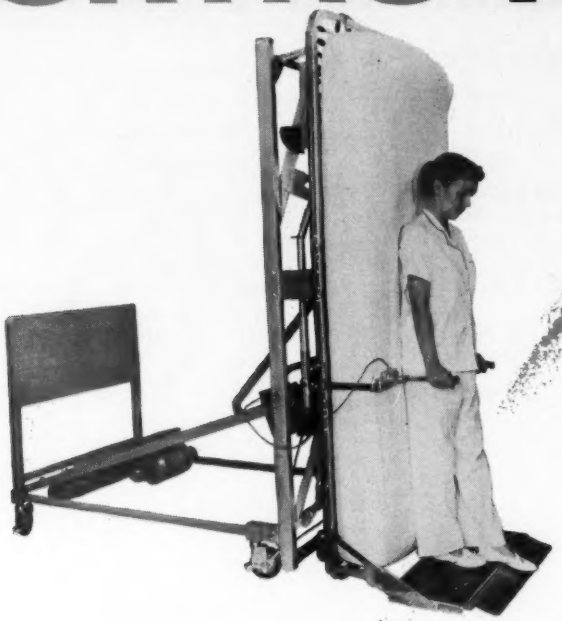

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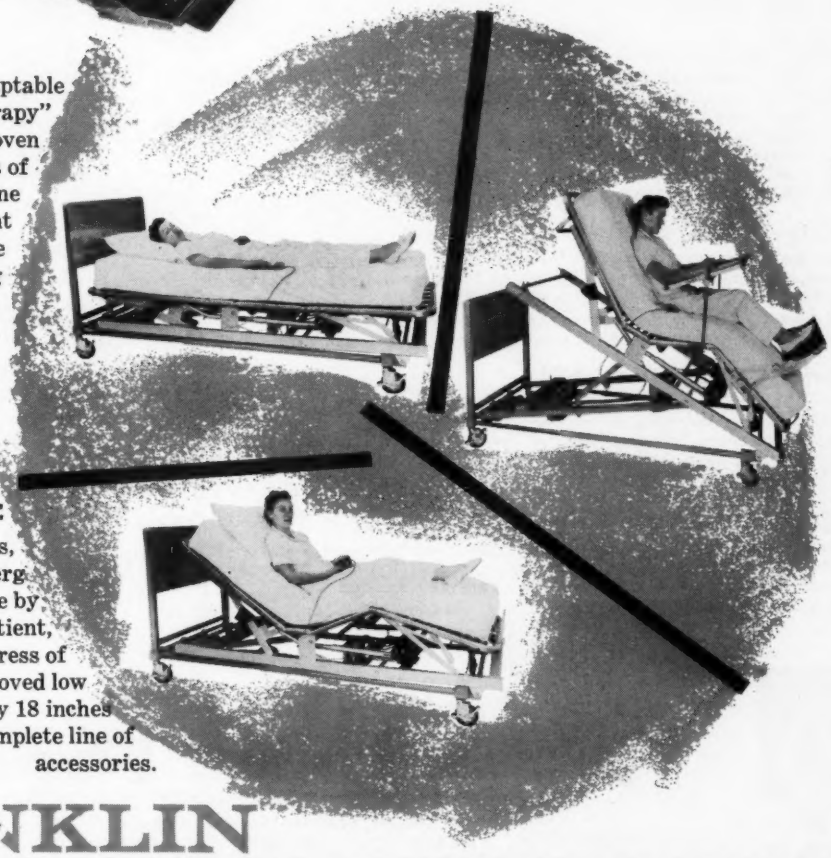

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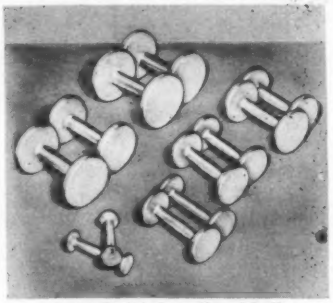

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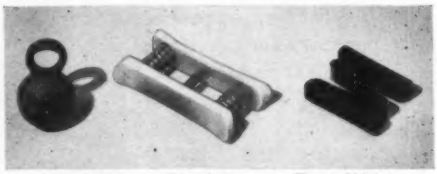

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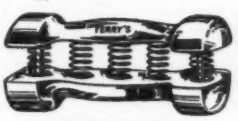

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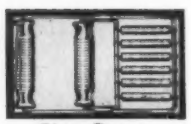

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THE JOURNAL OF THE ASSOCIATION FOR PHYSICAL AND MENTAL REHABILITATION

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THE NATURE OF CARDIOVASCULAR CONDITION IN NORMAL HUMANS (Part 4)

THOMAS KIRK CURETON, Ph.D., F.A.P.H.A.

Cardiovascular Component IV — Cardiovascular Fitness In Hard Athletic Exercise

The Meaning of Oxygen Resources

When one works at a task, oxygen is required to do the work. If the work is at a fast pace, the ability to take in enough oxygen into the blood to supply the need may not be great enough; then fatigue develops very rapidly. First of all, this is a matter of circulation. It is only the circulating blood through the lung capillaries which takes up the oxygen from the alveoli of the lungs. Fast circulation is a great advantage. Calculations show that it is worth vastly more than qualitative differences in the blood itself. Then, secondly, there is the transfer of oxygen from the capillaries to the working cells of the muscles. This is regulated by the difference in partial pressure of oxygen in the tissues compared with that in the capillaries of supply, modified by fat, body water and other factors. Thirdly, the breathing must be adequate in tasks which last longer than a minute or so.

The *first resource* is the oxygen immediately available to the working tissues. This comes through the capillary walls deep down within the tissues and bathes the cells. In the blood this oxygen is carried as oxyhemoglobin.

The *second resource* is then the reserve oxygen bound in combination with hemoglobin of the red blood corpuscles. As more and more need develops, more and more oxygen separates from the red corpuscles, where the partial pressure difference indicates that it is needed.

The *third resource* is the oxygen in the lungs, taken in by breathing. We usually measure the oxygen which disappears out of the fresh air breathed in —taking this as the difference between the per cent oxygen in the expired air and the inspired air, with careful correction for equivalent volumes and atmospheric conditions. This is the technique of gas analysis. It requires trained technicians to collect the gas in Douglas bags, to sample it in collection tubes, to meter it and correct the volume to standard conditions of temperature and pressure, and to analyze it by Haldane technique.

The *total oxygen* is the intake oxygen plus the oxygen drawn from the hemoglobin, commonly called *intake + debt oxygen*. This is the total to be drawn upon to accomplish work.[28,29,30,31]

The Prediction of Athletic Records in Endurance Events

Dr. A. V. Hill and R. M. Sargent, about 1926,[32] demonstrated that there was a systematic relationship between the speed of running and the oxygen consumed. They concluded that the oxygen cost of running increased at the 3.8th power of the athlete's velocity. More recently, Dr. Franklin Henry has compiled all of the available data and has suggested a slightly more accurate formula (*Research Quarterly, May, 1953, p. 169-175*).** The predictions are based on calculating the "Oxygen Requirement," a term devised by Dr. A. V. Hill in the beginning of the work. By "Oxygen Requirement" we mean all of the oxygen (both intake and debt) divided by the time of the work. This gives an average *rate* of using oxygen. It is an indirect way of estimating the velocity of the circulation, which is roughly proportional.

Since the oxygen intake capacity of the body is definitely limited, this determines the continued supply. If work is faster than the oxygen intake at the mouth, then over-draft is made upon the oxyhemoglobin reserves and an *oxygen debt* is developed. Both the *mouth intake* supply and the *oxygen debt* reserves may not be enough to supply the need, then fatigue quickly develops. Henry suggests that any running

---

*Professor of Physical Education, Director of the Physical Fitness Research Laboratory, University of Illinois.

**Henry's equation is:

$$\text{Running Speed (Yds/Secs)} = 9.6 - (5.7\, e^{-0.1037Y}) + (9.5\, e^{-0.575Y})$$

Y=Oxygen Requirement in L/Min.

[28]T. K. Cureton, "Heart Minute Volume in All-Out Maximal Endurance Exercises," *Am Jour Physiol.* 163:706-707, Dec. 1950.

[29]T. K. Cureton, "Treadmill Tests of Maximal Circulatory-Respiratory Capacity and Metabolic Efficiency," *Proc. Am. Assn. for Health, P.E. and Rec.*, 151-154, 1950.

[30]F. M. Henry, "Aerobic Oxygen Consumption and Alactic Debt in Muscular Work," *Jour. of Applied Physiol.* 3:427-438, Jan. 1951.

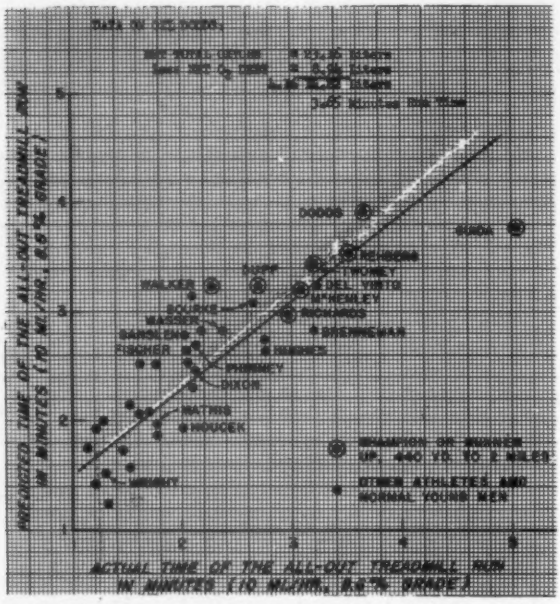
[31]A. V. Hill, "The Physiological Basis of Athletic Records," *Scientific Monthly*, 409-423, Oct. 1925.

[32]R. M. Sargent, "Relations Between Oxygen Requirement and Speed in Running," *Proc. Royal Society of London*, B. 10:100, 1926.

speed over four yards per second will usually develop an "oxygen debt." This means that oxygen will be depleted from the blood and other tissues, inducing feelings of distress, and such deficiency must be paid back before the person feels all right again.

Cureton[28] developed a second method, instituting a single test, with considerable economy of administration. From measuring the *oxygen intake capacity during an all-out run* in L./Kg. and the *rate of developing an oxygen debt* in the same run, a formula enables the calculation of time (predicted) of the run. The formula is: (for 10 Mi./Hr. and 8.6% grade)

TIME OF ALL-OUT TREADMILL RUN (in Standard Score) = 0.75 (O_2 Intake in L./Kg.) — 0.46 (Rate of O_2 Debt in L./Min./Kg.)


PREDICTED TIME OF THE ALL-OUT TREADMILL RUN IN MINUTES (10 MI./HR., 8.6% GRADE)
ACTUAL TIME OF THE ALL-OUT TREADMILL RUN IN MINUTES (10 MI./HR., 8.6% GRADE)
DIXON
WATTS
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OTHER ATHLETES AND NORMAL YOUNG MEN

Predicted Times By Cureton's Equation Related to Actual Times of All-Out Treadmill Run.

Fig. 18

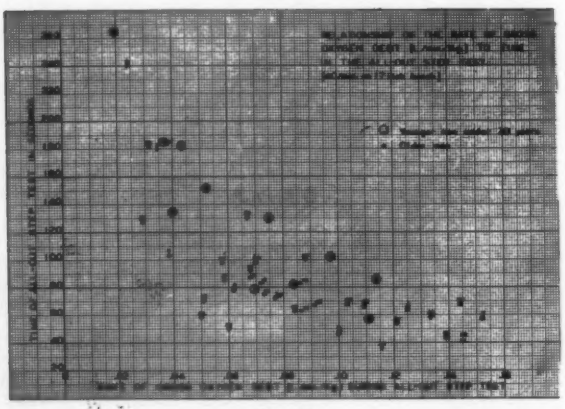

Fig. 19

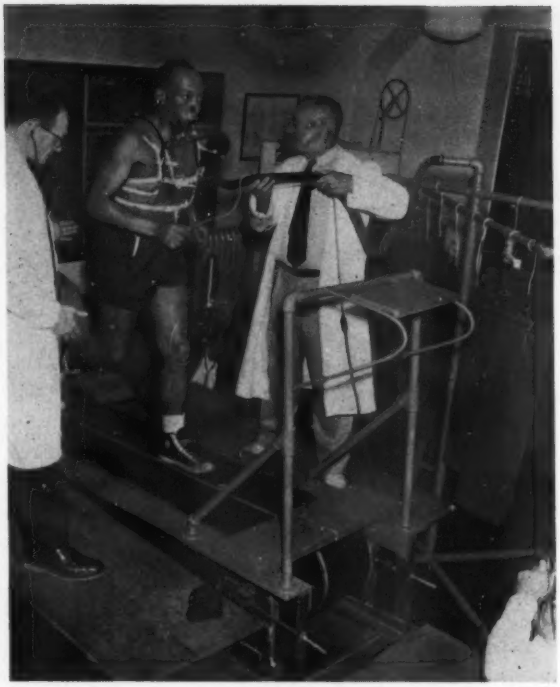

Fig. 20

Jesse Owens in All Out Treadmill Test at 40 Years of Age Jesse Owens exhibited fairly poor fitness in the all-out treadmill test and the associated Oxygen Intake and Debt measurements when he took this test at the Univ. of Illinois at age 40. His response to this and to the tests was to start a serious campaign to improve his fitness. He accomplished this in no small degree and then toured India demonstrating in dozens of exhibitions his ability as a sprinter and runner. It is interesting that he could lose so much fitness and then regain it in about a year of progressive training work.

After the run is made, the gas analyzed and the values substituted into the equation, the calculated standard score result can be looked up in our table for the predicted time of the run (p. 328, *Physical Fitness of Champion Athletes*).*** (Cf. Table VII).

This method does not necessarily determine the *maximal* oxygen intake which may be possible under any condition whatever, because there is an optimum pace for each individual in running. The oxygen in-

***Published by University of Illinois Press, 1951.
This equation gives an excellent "accounting" of the run in terms of oxygen because the multiple R of prediction is 0.97 ± 0.17 mins. It is important to note that the scale for the rate of oxygen debt is converted by subtracting the table value from 100 S.S. Unless this were done the sign between the items would be minus.
The equation means that the oxygen used in the run is the main component, weighted 0.75 compared to 0.46 for the *rate* of oxygen debt per Kg. of body weight. The oxygen debt alone is worthless as calculations showing Cureton's work. The top runner does not run up a large oxygen debt but may usually run up a smaller one because he runs more economically, which serves to keep the oxygen debt down to a lower level. In other words, the trained runner builds up his internal distress of oxygen deficiency much more slowly than an untrained person.

TABLE VII

RESULTS OF TESTING GILBERT DODDS
HEART SIZE AND ENERGY METABOLISM MEASURES IN ALL-OUT RUN, 10 MI./HR., 8.6% GRADE

	Oxygen Intake			Oxygen Debt			Total O_2					
S.S. %ile	Net* L/Min	Gross L/Min	Gross L/Min/Kg	Net L	Gross L	Gross L/Kg	Net L	Gross L	Gross L/Kg	Time of Run (Mins)	Time Mins and Secs	Heart Size**
100	4.21	4.52	0.561	16.59	23.58	.368	24.28	32.59	.489	3.90	3:54	26.05
95	4.01	4.32	.0522	15.79	22.65	.352	23.16	31.27	.468	3.72	3:43	23.49
90	3.90	4.16	.0499	14.99	21.72	.336	22.06	29.95	.447	3.65	3:39	20.93
85	3.61	3.92	.0476	14.19	20.79	.320	20.95	28.62	.426	3.38	3:23	18.37
80	3.41	3.72	.0453	13.39	19.86	.304	19.84	27.31	.405	3.20	3:12	15.81
75	3.21	3.52	.0430	12.59	18.93	.288	18.73	25.99	.386	3.02	3:01	12.03
70	3.01	3.32	.0407	11.79	18.00	.272	17.62	24.67	.363	2.84	2:50	10.69
65	2.81	3.12	.0384	10.99	17.07	.256	16.51	23.35	.342	2.66	2:40	8.13
60	2.61	2.92	.0361	10.19	16.14	.240	15.40	22.03	.321	2.48	2:29	5.57
55	2.41	2.72	.0338	9.39	15.21	.224	14.29	20.71	.300	2.30	2:18	3.01
50	2.21	2.52	.0315	8.94	14.28	.208	13.18	19,39	.279	2.12	2:07	1.45
45	2.01	2.32	.0292	7.79	13.62	.192	12.07	18.07	.258	1.94	1:56	—1.11
40	1.81	2.12	.0269	6.99	12.42	.176	10.96	16.75	.237	1.76	1:46	—3.67
35	1.61	1.92	.0246	6.19	11.49	.160	9.85	15.43	.216	1.58	1:35	—6.33
30	1.41	1.72	.2223	5.39	10.56	.144	8.74	14.11	.195	1.40	1:24	—8.89
25	1.21	1.52	.0200	4.59	9.63	.128	7.63	12.79	.174	1.22	1:13	—11.45
20	1.01	1.32	.0177	3.79	8.70	.112	6.52	11.47	.153	1.04	1:02	—13.01
15	.81	1.12	.0154	2.99	7.77	.96	5.41	10.15	.132	.86	:52	—15.57
10	.61	.92	.0131	2.19	6.84	.80	4.30	8.83	.111	.68	:41	—18.13
5	.41	.72	.0108	1.39	5.91	.64	3.29	7.51	.090	.50	:30	—20.69
0	.21	.52	.0085	.59	4.98	.48	2.18	6.19	.069	.32	:19	—23.25
M	2.21	2.52	.0315	8.59	14.28	.208	13.18	19.39	.279	2.12	2:07	1.45
Sigma	.68	.68	.0077	2.68	3.1	.0548	3.70	4.4	.073	.59	:36	8.55
N	36	34	36	35	33	33	33	33	33	36	36	114
Range	1.26--	1.61--	.0497--	3.33--	8.52--	.364--	7.23--	12.00--	.414--	1.28--	1:17--	—23.7 --
	3.73	4.15	.0161	16.26	20.76	.100	21.06	27.35	.152	3.30	3:18	+19.8

* "Net" means the gross value minus the *sitting* metab olism. "Gross" includes the sitting oxygen.

** Figures are in terms of ±% on the Ungerleider-Clark Tables.

take is usually a bit higher in all-out cycling and somewhat less in all-out swimming. If the muscles are weighted heavily, as in weight bearing, the oxygen intake may be somewhat reduced. All we can say is that the result indicates what the individual could do on the particular test at that pace. Some subjects cannot run hard without tensing up greatly, thereby reducing their oxygen intake and building up their oxygen deficiency relatively more quickly.

It has been our practice to collect all of the gas during the run in one bag, and limit the test to that amount of running. This makes for great economy in the administration of the test. The recovery oxygen may take one, two or three bags for collection during a half-hour period. We very frequently limit this collection time to 15 minutes, with very small error. A study of the build-up of the oxygen intake during each minute of a run, by using a series of smaller bags, shows that the intake gets greater up to about two-thirds of the way through the run. Then the subject begins to get inefficient. This causes the oxygen intake curve to go downward, indicating that he is getting less oxygen per minute than while at the peak of his efficiency. Tensing, grimacing, and wobbling may be observed. The stride may shorten and increase in pace a bit. All of this hurts circulation, and since the oxygen intake depends upon the amount of blood that can go through the heart-lung circuit, there may usually be reduced oxygen intake because the tension hurts the circulation. Only the very expert runner, who can run "ballistically" even though he is tired, is able to keep his oxygen intake curve sloping upward. (Cf. Fig. 21)

High Oxygen Intake Needed for Efficiency in Hard Work

In an easy task efficiency is greater if the oxygen used is relatively small. When the task is hard enough to tax the body (develop 3 liters of O_2 debt or more) then the greater the intake of oxygen the greater is the efficiency in terms of lasting longer. The smaller the oxygen intake the shorter will be the time of the

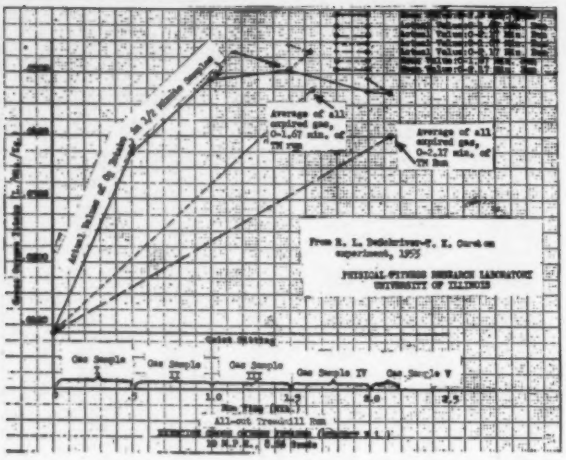

Fig. 21

Serial Bag Determination of Gross Oxygen Intake (L./Min./Kg.)

run in an all-out run. A group of 20 athletes in good training had as an average 71.95% more total oxygen used in an all-out run than 18 relatively untrained men; the athletes had 17.26% greater rate of gross oxygen intake in liters per kilogram of body weight than the untrained men.[28,29]

Champion athletes have an unusually high oxygen intake capacity, especially if they are endurance athletes. For instance, Gilbert Dodds, the mile indoor champion, had 4.16 liters of gross oxygen intake (at the mouth) and an additional reservoir of 8.94 liters during an all-out treadmill run at 10 mi./hr., 8.6% grade. It was estimated that he was able to clear more than 30 liters of blood flow per minute through the heart-lung circuit and developed a stroke volume of 167 cc. for each beat of the heart. Astrand[33] has reported figures even higher obtained by running his men on the flat and at a somewhat slower pace (about 6.5 miles per hour) for a much longer time. In 1925 Drs. Yandell Henderson and Howard W. Haggard[34] at Yale University, tested the members of the 1924 Olympic Crew that won the 8-oared title in 1924, all Yale students. The work per stroke was calculated at 375 foot pounds net, and 469 foot pounds with allowance of 25% for efficiency losses. The calories burned were 4.5 (at 30 strokes per min.) and 6.0 (at 40 strokes per min.) for every minute of hard rowing. These men averaged 0.418 L./Min. for quiet resting metabolism and 3.51 L./Min. for oxygen intake net during the rowing work, covering a mile in about 5:00 mins., 40 strokes per minute.

A demonstration was made at the Harvard Fatigue Laboratory in 1936 by Drs. Sid Robinson and D. B. Dill when they tested four of the world's top milers, Don Lash, San Romani, Venske and Fenske. Lash had just broken the world's outdoor 2-mile record in the Olympic trials. In the Harvard test for maximal oxygen intake, after adequate warm-up, he was found to have a capacity of 5.35 L./Min. This was announced as "New Records in Human Power." This was equivalent to about 40 liters of blood per minute through the heart-lung circuit.

In 1948 Cureton announced that Gilbert Dodds was found to have unusual oxygen intake capacity in terms of L./Min./Kg. (0.0561). (Cf. Fig. 19). Dodds was not in the very best condition and George Guida, an Olympic relay runner, made a very unusual record in our laboratory. (Cf. Fig. 21.) *

Still again in 1956 Astrand[33], in Stockholm, reported large oxygen intake capacities for several of the world's best milers:

	1	2		1		1	2
G.B.	74	(4.81)	A.W.	65	K.F.	56	
H.E.	69	(5.29)	B.L.	63	J.L.	76.6	(5.04)
A.O.	65		L.A.	58			

1—c.c./m./kg;
2—L./Min.

Differences in Method, Need of a Quick Test

Cureton[29,35] standardized a test of the "all-out" type on the treadmill, 8.6% grade, 10 miles per hour, to test athletes in their all-out run time and at the same time obtained the collection of *all* of their expired gas, and also in different Douglas bags all of the recovery gas during the period of recuperation until the pulse rate and blood pressures had leveled off for three minutes. The test is a very valid fitness test and yields proportionate gross oxygen intake values (L./Min./Kg.) and *total oxygen* (Gross Intake + Net Debt) values. This might be called an "Athletic All-Out Performance Rating Treadmill Test." Its validity is shown in Fig. 18 wherein top athletes are shown to be superior to others in the relatively untrained state. Cureton's formula gives results which

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**Cureton's method involved a single hard run, 10 mi./hr./8.6% grade, with warmup, but with collection of gas all in one large Douglas bag during the run, then the recovery gas in two or three other Douglas bags. With various subjects this all-out run varied in duration from 1.5 to 5.3 mins. It had the advantage of giving all-out run time, which gave a real basis for determining the lasting quality of the subjects. Instead of "maximal" oxygen intake, the oxygen intake was the highest the subject could give under this system. The method is not comparable with Astrand's, which did not give the endurance performance of the subjects in the run.

[33]P. O. Astrand, "Human Physical Fitness with Special Reference to Sex and Age," *Physiol. Reviews* 36:307-335, 1956. Also "Physiological Evaluation of the Performances in Sport," *FIEP Bulletin* 2:52-55, 1954

[34]Y. Henderson and H. H. Haggard, "The Maximum of Human Power and Its Fuel," *Am. Jour. Physiology*, 72:264-282, 1925.

[35]T. K. Cureton, "Heart Minute Volume in All-Out Maximal Endurance Exercises," *Am. Jour. Physiol.* 163:706-707, Dec. 1950.

are highly related to the actual time of the treadmill run. Actually, this is the first time that a statistical regression equation has been applied to the problem of relating the best of the oxygen intake and oxygen debt measures to actual performance of individuals. The method is very satisfactory for rating individuals. The oxygen values are not "maximal," nor are they intended to be. Higher values have been obtained in slower pace work, carried on for a longer time, and especially on a bicycle rather than a treadmill.

The method developed at Illinois fits the need for a quick test of high level athletic ability. The reasoning is centered on the principle that athletic work, such as the mile run, a 100-yard swim, or a crew race, all require quick adjustment of the circulation to as high a level of turn-over as can be developed. Warm-up is always advocated for 20-minutes or more; then from the very start the run is hard and fast. The better the training of the subject, the better he can adjust, and respond with a relatively large circulation. The measures should be divided by body weight to give optimal circulatory meaning to the results.*

Fig. 21 shows the serial bag scheme of determining gas samples progressively throughout the run at half-minute intervals, developed in our research laboratory. After adequate warm-up the subject is started on the treadmill simultaneously with opening the valve to the first Douglas bag. Bag 1 is held open just 30 seconds. When Bag 1 is closed, Bag 2 is simultaneously opened—and so on throughout the series.

The results show the comparison of running with serial bag collection at half-minute intervals, and running several runs (1) 1.67 mins. (2) 2.17 mins. with gas taken for the whole period of the run, i.e., 0 to 1.67 and 0 to 2.17 mins. In the latter case the gas is thoroughly mixed and then sampled, so the result is an "average" sample for the time of the run. Comparison of the *actual* with the *average* (mean) values shows that the actual values are about 30 cc./min./kg. higher than the mean values. The highest values were the actual 1/2 min. collections with the timing 15 secs. before and 15 secs. after the point as plotted. Thus, we show that the single run bag does not give the highest values of oxygen intake but this method saves much time, being the only feasible method when only one day is available to test a subject.[36]

Taylor et al[37] have used a more accurate method for "maximal" oxygen intake since 1955 but the method is very costly in man-hours, requiring the subject to be tested on several different days, with many more gas samples to be analyzed than in our method. In brief, Taylor's method consisted of a 15 minute warm-up at 3.5 miles per hour at the grade to be used. Then the subject ran at 7 miles per hour at 6% grade, with

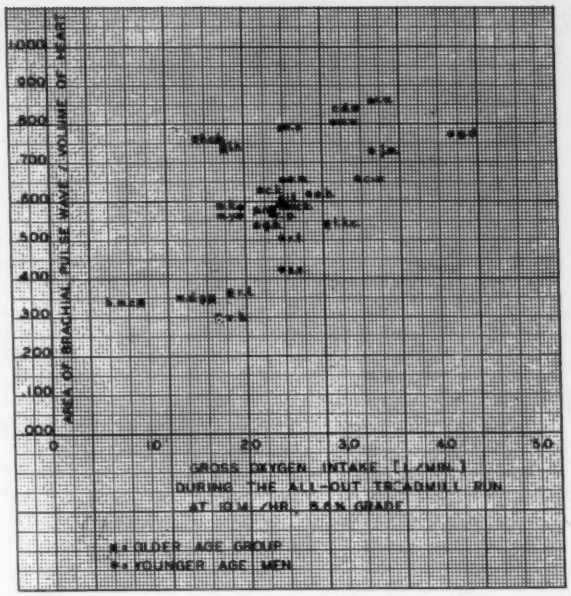


Fig. 22

Relationship of the Area of the Brachial Pulse Wave to Gross Oxygen Intake During Maximal Work.

The Brachial Pulse Wave taken under standardized conditions has a high relationship to Gross Oxygen Intake during maximal work. In fact, the Brachial Pulse Wave is the only test given in quiet state which has been discovered to be so highly associated with Oxygen Intake resulting from a hard treadmill run.

gas collected between 1:45 and 2:45 of running. The procedure was repeated at grades of 8.5 and 11 per cent on other days with a day of rest allowed between runs. Maximal oxygen consumption was assumed to be reached when running at the next higher grade did not increase the maximal oxygen intake more than 150 cc. above the previous grade.

The most obvious type of efficiency which we note (and it is always in the mind of the spectators, too) is the ability of an athlete to continue fast pace work for a relatively long period. In other words, as the 440 or 880 yard races round into the final drive for the finish, the best conditioned athletes will sustain the pace and others will fall slowly to the rear. In the athletic sense, the best athlete lasts longer at

*Report 208, "Relationship of Maximal Oxygen Consumption to Various Components of Body Composition," U. S. Army Medical Nutrition Laboratory, Fitzsimmons Army Hospital, Denver, Colorado, (July 23, 1957) by E. B. Welch, R. P. Riendieu, C. E. Crisp, and R. S. Isentein—showed that 35% of the variations in maximal oxygen consumption may be accounted for by weight.

[36]R. L. DeSchriver, "Progressive Changes in Oxygen Intake and Oxygen Debt in Treadmill Running," Urbana: M. S. Thesis, Physical Education, Univ. of Illinois.

[37]H. L. Taylor, E. R. Buskirk and A. Henshel, "Maximal Oxygen Intake as an Objective Measure of Cardio-respiratory Performance," *Jour. Appl. Physiol.*, 8:73-80, 1955.

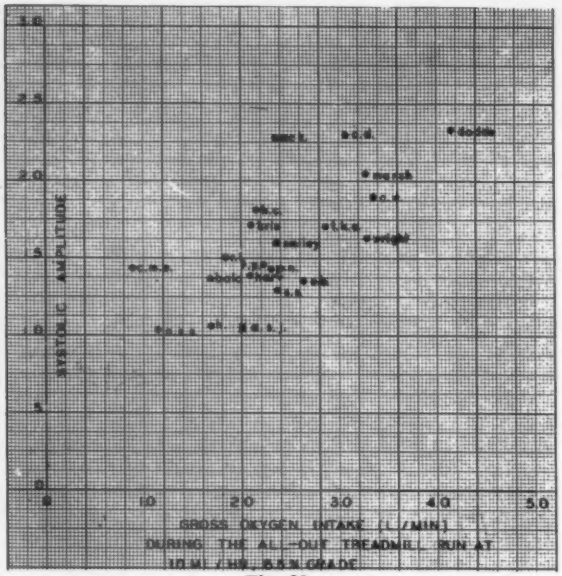


Fig. 23

Relationship of the Systolic Amplitude to Gross Oxygen Intake.

The Systolic Amplitude of the Brachial Pulse Wave is also highly related to Gross Oxygen Intake. We consider that Gross Oxygen Intake is the best circulatory criterion to use in hard workout on the treadmill. The conditions at quiet sitting are highly equivalent and the entire run forms the Oxygen taken in during the time of the run. The circulation is proportional during the run to both of these so they are added together and used as the Gross Oxygen Intake.

the pace necessary to win. Circulatory efficiency, in terms of total oxygen reserves, is the main determining factor in success.

Most races are carried out to very near the "all-out" point. This does not mean absolute exhaustion but only the temporary limit beyond which will power cannot make one go. The main problem is being able to get the circulation up to capacity as quickly as possible and to turn over the largest possible amount of blood per minute while running. This is the need in all races up through the mile. So, we say that on our test a man with 30 cc./min./kg. of gross oxygen intake is better than one with 20; and one with 40 is better than one with 30; and one with 60 is very unusual, in the class with Gil Dodds, George Guida, Roger Bannister or John Marshall. Beyond a doubt this type of circulatory capacity dominates the results in races on the track, in swimming, cycling, skiing, rowing and all such races of distance in terms of time.

On the basis of testing John Marshall at Urbana in 1950, the writer announced that he had one of the greatest circulations during hard work ever observed. Inside of six months Marshall established five world's records in swimming. In 1952 the writer announced after testing Roger Bannister that he had the most remarkable circulation that he had ever observed and predicted to Londoners that the man to break the 4-minute mile barrier was right there in London. In little over a year, Bannister did the trick, and my prediction was recalled.

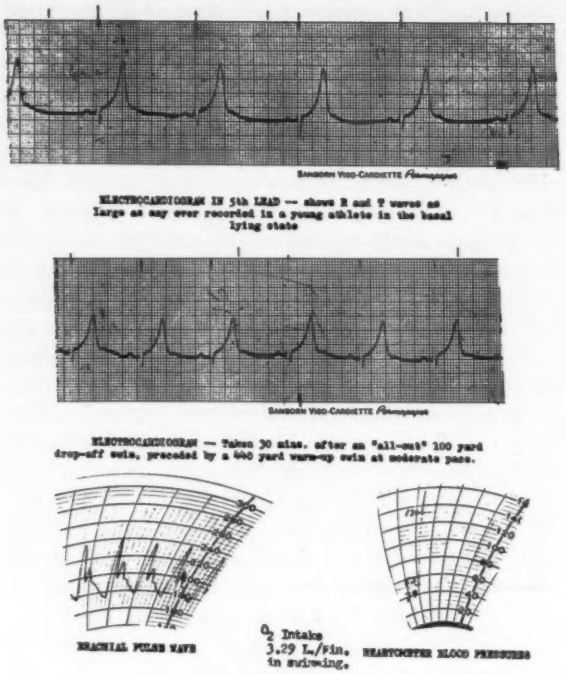

ELECTROCARDIOGRAM IN 5th LEAD -- shows R and T waves as large as any ever recorded in a young athlete in the basal lying state
ELECTROCARDIOGRAM -- Taken 30 mins. after an "all-out" 100 yard drop-off swim, preceded by a 440 yard warm-up swim at moderate pace.
BRACHIAL PULSE WAVE
O_2 Intake 3.29 L./Min. in swimming.
HEART-CENTER BLOOD PRESSURES

Fig. 24

Heart Records of John Marshall

(World record holder in 200 (220) and 400 m. (440 yds.)

220 m. in 2:09.6 **400 m. in 4:29.5**

200 yds. in 2:05.5 **440 yds. in 4:31.2**

John Marshall, Australian swimming champion, came to the U. S. and broke five world's records in the few months following our tests of him at the Physical Fitness Research Laboratory at the Univ. of Illinois. Perhaps our tests helped to build his confidence and motivated him to the highest possible efforts in the next few months. When Coach Bob Kiphuth of Yale sent him to us this was his hope for he observed the effect of such testing on the 1948 swimmers who were tested at Detroit just following the Olympic rounds and before swimming at London, England. Marshall's figures for Cardiovascular Fitness are among the best we have ever taken and are comparable to those of Roger Bannister in track. The Oxygen Intake figures quoted for Marshall came from testing him in the pool by means of gas collection hoses fed to him through a supporting head cap. The full record of this work for 48 different tests on 41 college swimmers appears in W. D. VanHuss and T. K. Cureton's "Relationship of Selected Tests with Energy Metabolism and Swimming Performance," *Research Quarterly*, 26:205-221, May, 1955.

Some Interesting Comparisons in Circulatory Capacity and Cardiovascular Condition

Subjects with relatively high oxygen intake capacity under hard work conditions are generally higher in many of the cardiovascular fitness test items. This is shown by Tables VIII and IX. Normal young men are fitter by most of the tests and indices shown in

TABLE VIII

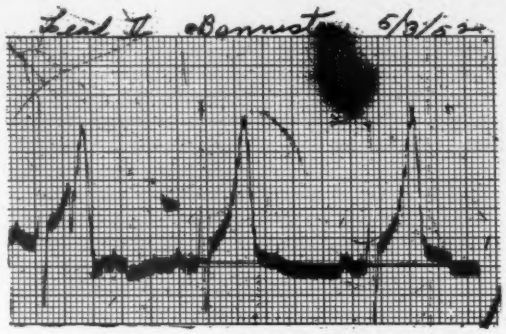
PHYSICAL FITNESS TEST AVERAGES OF FORMER ATHLETES, NORMAL ADULT MEN AND YOUNG MEN

Test Items	Units	Former Athletic Champions	Normal Adult Men	Normal Young Men
	No. of Cases	55	200—500	200—500
A. BODY BUILD	Range	27-62	26-60	17-25
1. Age	Years	44.09	45.0	21.0
2. Height	Inches	69.37	69.36	69.84
3. Weight	Pounds	165.29	170.05	151.0
4. Caliper Fat (Pinched-up in 6 Places)	mm.	78.84	139.1	131.0
B. PULSE RATE				
5. Lying Pulse Rate	Beats/Min.	60.24	77.1	73.0
6. Standing Pulse Rate	Beats/Min.	73.36	87.0	85.0
7. Pulse Rate Change, Lying to Standing	Beats/Min.	12.94	16.0	12.0
C. BLOOD PRESSURES				
8. Systolic Blood Presure (lying)	mm. Hg.	120.0	122.2	122.0
9. Diastolic Blood Pressure (lying)	mm. Hg.	74.2	75.0	76.0
10. Change in Pulse Pressure (lying to standing)	mm. Hg.	—9.67	—6.06	
D. CARDIOVASCULAR INDICES				
11. Metabolic Rate (by Gale Index)	%	15.45	—9.0	—4.7
12. Tigerstedt Index (Pulse Pr./Sys. Pr.)		0.294	0.280	0.444
13. Barach Index (Sys. B.P. + Dias. B.P.) x P.R.)		150.8	176.0	141.0
14. Stone Index (Pulse Pr./Dias. B.P.)		0.435	0.420	0.840
15. Erlanger-Hooker Index (Pulse Pr. x P.R.)	Pts.	2645.9	2956.0	3932.0
16. Cureton Cardiovascular Index	S.S. %	65.84	53.0	52.5
17. Schneider Index	Pts.	15.3	12.0	11.0
18. Average Progressive Pulse Ratio		2.52	2.53	2.40
E. SPHYGMOGRAM (Heartograph Pulse Waves)				
19. Area/Surface Area of Brachial Sphygmogram by Cameron Heartometer	Sq. Cm./Sq. m.	0.262	0.204	0.160
20. Systolic Amplitude of the Brachial Sphygmogram (by Cameron Heartometer)	Cm.	1.58	1.44	1.16
21. Sitting Pulse Rate (by Heartometer)	Beats/Min.	68.3	77.0	79.0
F. RECUPERATION PULSE RATES				
22. Five Min. Step Test	Beats	149.5	176.0	158.0
G. RESPIRATORY				
23. Expiratory Force (Blowing)	mm. Hg.	197.0	117.0	163.0
24. Breath Holding (Normal)	Secs.	73.8	50.0	69.0
25. Breath Holding After 1-Min. Stepping at 10/Min. on 17-inch Bench	Secs.	15.4	10.5	16.8
H. METABOLISM AND HEART SIZE				
26. Basal Metabolic Rate	%	—8.0	—12.0	—3.50
27. Area of Pulse Wave/Area of Dias. X-Ray of Heart		3.489	2.599	3.442
28. Oxygen Intake Capacity During All-Out Treadmill Run 7/Hr., 8.6% Grade	L./Min.	1.91	1.20	2.21
29. Rate of O_2 Debt During All-Out Run	L./Min./Kg.	0.032	0.020	0.056
30. Heart Size, Related to Normal	%	4.73	6.17	0.60

TABLE IX

COMPARISON OF HEART AND CARDIOVASCULAR TESTS

	Item	Units	Normal Young Adults	Roger Bannister	Jesse Owens	Joie Ray
1.	Age	Yrs.	27.4	23.0	40.0	60.4
2.	Height	Ins.	69.4	73.5	69.75	64.5
3.	Weight	Lbs.	167.9	150.0	187.0	154.0
4.	Weight	Kg.	76.3	68.2	85.0	70.0
5.	Surface Area	Sq. m.	1.91	1.87	1.99	1.77
	ALL-OUT TREADMILL RUN, 8.6% GRADE					
6.	(or All-Out Step Test, 17")		135.0	315.0*	68.0	99.0
7.	40/Min.*	Secs.	2:15	3:00*	0:36*	1:39
8.	Predicted Time	Mins.	2:58.5	3:13*	1:08	1:46.2
	HEART SIZE:					
9.	Transverse Diameter	Cms.	13.30	15.40	15.30	11.70
10.	Right Diameter	Cms.	4.35	4.66	5.6	3.41
11.	Left Diameter	Cms.	8.96	10.60	9.8	8.46
12.	Ratio: Rt./L.		1/2.15	1/2.27	1/1.75	1/2.45
13.	Heart Size ± Normal	%	1.38	25.1	10.78	—11.37
14.	Long Diameter	Cms.	14.66	15.40	16.30	11.80
15.	Short Diameter	Cms.	11.62	12.70	13.30	9.10
16.	Depth	Cms.	10.80	13.00	12.80	12.70
17.	Volume (as a sphere)	Cm^3	1257.1	1861.0	1908.0	875.0
18.	Volume (Liljestrand)	Cm^3	707.5	968.0	1055.0	520.0
19.	Volume (Keys and Fridell)	Cm^3	747.0	1068.0	1150.0	439.0
20.	Area Frontal x-ray (dias.)	Cm^2	131.1	168.4	177.5	91.4
21.	Resting Stroke Volume (Grollman)	cc./beat	60.8	52.0	51.0	81.0
22.	Area Brachial Pulse Wave	Cm^2	.50	.60	.43	1.21
23.	Area Brachial Pulse Wave/S.A.	Cm^2/sq. m.	.261	.321	.191	.685
	HEART EFFICIENCY:					
24.	Cureton (1) $\frac{\text{Area Brachial P.W.}}{\text{Area Frontal X-ray}} \times 1000 =$		3.801	3.57	2.42	13.24
25.	Cureton (2) $\frac{\text{Area B.P.W.}}{\text{S.A. x Area Fr. X-ray}} \times 1000 =$		.678	1.91	1.22	7.48
26.	Cureton (3) $\frac{\text{Area B.P.W.}}{\text{Volume (Keys \& Fridell)}} \times 1000 =$		.666	.299	.374	2.76
27.	Keys (4) $\frac{\text{Stroke Volume}}{\text{Volume (Keys \& Fridell)}} \times 100 =$		8.22	11.82	4.33	18.47
28.	Nylin (5) $\frac{\text{Volume (Liljestrand)}}{\text{Stroke Volume}} =$		12.72	18.62	20.70	6.43
	OXYGEN INTAKE (Metabolic Efficiency in All-Out Exercise)					
29.	Net O_2 Intake	L/Min.	2.21	3.23	2.31	1.58
30.	Gross O_2 Intake	L/Min.	2.52	3.52	2.60	1.82
31.		L/Min./Kg.	.0315	.0517	.0315	.0222
32.		L/Kg.	.0548	.1550	.0347	.0430
	OXYGEN DEBT (oxygen Deficiency During All-Out Exercise)					
33.		L.	8.59	3.47	8.94	5.32
34.		L/Min./Kg.	.056	.017	.093	.046
	Pulse rate after All-Out Run	beats	182.	170.	172	180.
	ELECTROCARDIOGRAM:					
35.	T (IV or V)	mm.	9.66	25.3	5.1	4.5
36.	R (IV or V)	mm.	25.27	27.0	21.1	24.7
37.	5-MIN. STEP TEST	beats	169.	87.0	188.	182.
38.	BREATH HOLDING (after 1' stepping 16" chair, 30/Min.)	Secs.	21.	20.	35.	35.
	BLOOD PRESSURES, PULSE RATES, COMBINATIONS					
39.	Pulse Rate, sitting	Beats/Min.	79	49.	63.	60.5
40.	Blood Pressures, sitting	Mm. Hg.	121/77	114/78	104/77	132/93
41.	B.P. after All-Out Run	Mm. Hg.	185/76	170/60	202/84	220/120
42.	Schneider Index	Points	11.	19.	17.	18.
43.	Barach Index	Points	141.	117.6	156.8	155.4
44.	Av. Progressive Pulse Ratio		2.400	2.340	2.704	2.458
45.	P. R. after All-Out Run	Beats/Min.	148.0	120.	172.	172.



ECG — HIGHEST PRECORDIAL LEVEL

R = 26.8 mm. (56 S.S.)
Ratio T/R = 1.0261
S = 8.5 mm.
T = 27.5 mm. (161.5 S.S.)
ST elev. = + 4.5. mm.

BRACHIAL SPHYGMOGRAM

(Heartometer Pulse Wave, Cameron Heartometer)

Area = .60 sq. cm. (77 S.S.)
Area/S.A. = 0.321 (71 S.S.)
Sys. Amp. = 1.77 (62 S.S.)
Sys. B.P. = 134 mm. Hg. (34 S.S.)
Dias. B.P. = 71 mm. Hg.
Pulse Rate = 64/min.
Ejection Angle = 9° (63 S.S.)
S.V. = 57 cc./beat
P.P. = 63 mm. Hg.

Gross O_2 Intake in All-Out Step Test: 5'15" at 40 steps per min.; 3.52 L./Min. (75 S.S.); 3.47 Liters of Net O_2 Debt; 0.116 L./Min./Kg. of O_2 Debt.

X-RAY FRONTAL

Rt. Diam. = 4.66
L. Diam. = 10.6
Aortic Diam. = 4.81 cms. (71 S.S.)
Area = 168.45 sq. cm. (27 S.S.)
Ratio LD/RD = 2.2747 (43 S.S.)
Trans. Diam. = 15.26 (27 S.S.)
Axis Dev. = 11° (Normal)

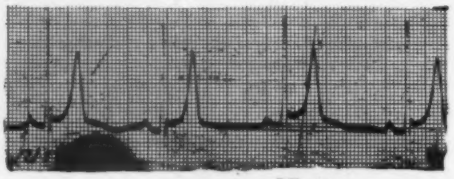
OTHER FITNESS MEASURES

Strength = 768 lbs. (33 S.S.)
St./Wt. = 5.12
Fat = 52 mm. (96 S.S.)
5-Min. Step Test = 87.0 (very poor)
Schneider Index = 19 (75 S.S.)
Barach Index = 117.6 (80 S.S.)
Cureton CV Factors = 71 S.S.

Fig. 25 Superb Cardiovascular Condition*
Roger Bannister Age 23 Height 73.5 Weight 150 lbs. S.A. 1.87 Sq. mm.
(Former mile champion of England; the first man to run a 4-minute mile)

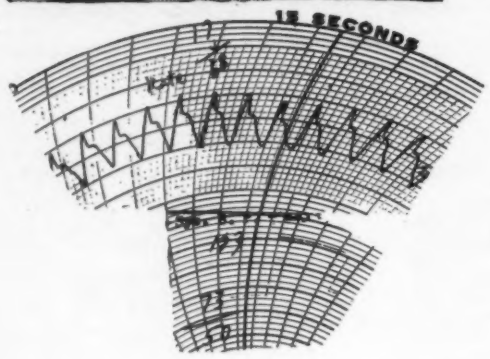
Table VIII. This is true of the Tigerstedt, Stone, Erlanger-Hooker Index, Cureton's CV Index, B.M.R. Index and Average Progressive Pulse Ratio, all being tests given in the quiet or submaximal exercise state. A group of former athletic champions show lower pulse rates, blood pressures, with higher Schneider Indexes, better pulse rate recuperation after the 5-minute step test and lower caliper fat than the young men. In the group of 55 former champions were 30 who kept up regular training exercises of one kind or another. The former champions are better in fitness than normal middle aged men in many other test items including larger sphygmograms (by heartometer graphs), greater expiratory force, breath holding ability and all-out run time on the treadmill (or all-out step test time at 40 Steps/min.). They also have slightly smaller hearts for their height and weight.

In Table IX we have compared a great young athlete (Roger Bannister) with a great former athlete at 40 years of age (Jesse Owens), and both with the



ECG — HIGHEST PRECORDIAL LEAD

R = 28.0 mm. (75 S.S.)	T = 19.8 mm. (110 S.S.)
Ratio T/R = 0.707	
S = 1.0 mm.	ST/elev. = + 3.5 mm.



BRACHIAL SPHYGMOGRAM
(Heartograph Pulse Wave Standardized)

Area = 0.45 sq. cm.	Pulse Rate = 68/min.
Area/S.A. = 0.247 (57 S.S.)	S.V. = 41 cc/beat (61 S.S.)
Sys. Amp. = 1.34 cms.	Dias. B.P. = 73 mm. Hg.
Sys. B.P. = 123 mm. Hg. (50 S.S.)	P.P. = 50 mm. Hg.

X-RAY FRONTAL

Rt. Diam = 4.78 cms.	(58 S.S.)	Trans. Diam. = 13.84 (44 S.S.)
L. Diam. = 9.06 cms.	Area = 157 sq. cms. (34 S.S.)	Axis Dev. = 74° (normal)
Aortic Diam. = 5.34 cms.	Ratio LD/RD = 1.897 (41 S.S.)	

OTHER FITNESS MEASURES
Ran 1:23.4 on Treadmill Equivalent Test (40 Steps/Min. on 17" Bench

Strength = 1155 lbs.	5-Min. Step Test = 169 (58 S.S.)	WBC = 5850 to 6450
St./Wt. = 7.29	Barach Index = 130.56 (56 S.S.)	Es = 2.0 to 3.0%
Fat = 81 mm.	Schneider Index = 18 (80 S.S.)	TP = 6.59 to 7.94
W/R = + 11.2 lbs.		Hb = 15.92 to 16.95
Post Ex. B.P. = 150/82 from 118/94		RBC = 5.30 to 5.62 m.

Fig. 26 Good Cardiovascular Condition*

Lauri Lehtinen Age 43, 11 mo. Height 68.5 Weight 158.4 lbs. S.A. 1.85 Sq. mm.

(Former Olympic Champion, 1932. 5,000 meters in 14:30.0 & holder of World's Record in 14:17.0 made in 1932)

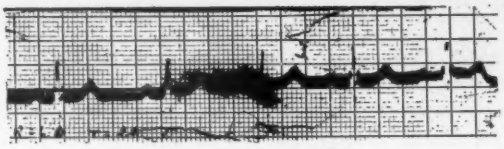
greatest older runner in the United States (Joey Ray) at 60 years of age. Bannister's great superiority in the oxygen intake tests during hard work is outstanding. His endurance in running and in stepping all-out on the bench at 40 steps per minute are out of the class of the others. But Joey Ray has the smallest heart, any way it can be measured, and has the largest sphygmogram (brachial pulse wave), and has by far the largest T-wave in the precordial electrocardiogram. His performance in the 5-minute step test set a record in our books. We also note his very low pulse rate at rest, very low blood pressured after his all-out effort, followed by very low terminal pulse rate at the end of the effort. In all of the quiet computed indices from pulse rates and blood pressures Bannister has a great advantage. His oxygen intake capacity most truly predicts his running or all-out stepping ability.

Value for Everyone of High Oxygen Intake Capacity

We are convinced that relatively high oxygen intake capacity is very valuable for everyone. It means that the heart and lungs and muscles are able to pass the blood relatively easily, that they are not "stuffed up" with cholesterol, lymph, or "guk" (a term used by Dr. J. B. Wolffe). The presence of this "guk" can actually be seen in the abdominal aorta x-rays of some subjects. To a greater or lesser extent all of the main arteries are relatively free and unconstricted, or are smaller and constricted, depending upon the degrees of atherosclerosis and/or nervous constriction, but regardless of what the cause is, the oxygen intake test tells us how much blood can move through the heart-lung-muscle circuit to a very close estimate.

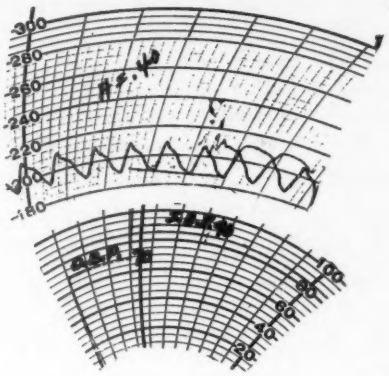
So, the type of circulatory fitness defined by Hill in terms of "oxygen requirement" is just as valuable for ordinary people in that they, too, need good circulation, need to be able to meet emergencies, and there is the belief that the more total capacity the circulation has, the farther away from clogging up, the person is apt to be.

The first trends of evidence are now with us to



ECG — HIGHEST PRECORDIAL LEAD

R = 6.0 mm. (32 S.S.)
S = 3.6 mm.
T = 2.1 mm. (2 S.S.)
Ratio T/R = 0/.35
ST elev. = 0



BRACHIAL SPHYGMOGRAM

(Heartograph Pulse Wave, Standardized) — weak or depressed

Area = 0.40 (52 S.S.)
Dias. B.P. = 70 mm. Hg. (50 S.S.)
Area/S.A. = 0.2439 (55 S.S.)
P.P. = 20 mm. Hg. (17 S.S.)
Sys. Amp. = 0.68 cms (50 S.S.)
Pulse Rate = 72/Min. (56 S.S.)
Sys. B.P. = 90 mm. Hg. (87 S.S.)
S.V. = 24 cc/beat

X-RAY FRONTAL

Rt. Diam. = 4.0
L. Diam. = 7.08
Aortic Diam. = 4.45 (84 S.S.)
Area = 90.4 sq. cm. (90 S.S.)
Ratio LD/RD = 1.77
Trans. Diam. = 11.1 cm. (79 S.S.)
Axis Dev. = 56° (Normal)

OTHER FITNESS MEASURES
(Not able to take hard exertion tests)

3½ Mi. Treadmill Jog = 2:52
Net Oxygen Intake = 1.320 L./M. (R.Q. = 1.27)
Net Oxygen Debt = 3.349 L.
Vital Cap. Residual = — 4 cu. ins. (52 S.S.)
Cureton CV Factor = 51.1 S.S.
B.M.R. = ... 19.2%
5 Min. Step Test—Could not do (at 24/Min. developed chest pain after 2 min.
Barach Index = 198.7 (40 S.S.)
Schneider Test = 12 (45 S.S.)

Fig. 27 Poor Cardiovascular Condition*

Marjorie Smith Age 34 Height 65.5 Weight 122 S.A. 1.64 Sq. mm.

(Railroad telegrapher and switch operator; in poor health; had rheumatic fever one year ago.)

indicate the value of exercise for opening up the circulation, keeping it open, and by reducing the cholesterol levels of the blood. Several studies have appeared which indicate the value of exercise to control the blood cholesterol.

Other Methods of Testing Component IV

1. *Terminal Pulse Rate.* The pulse may be taken within the first 15 second interval immediately after the cessation of the effort. Montoye[35] demonstrated with data obtained from the Harvard Fatigue Laboratory that the terminal pulse rate correlated 0.66 with the blood lactate measured 6-10 mins. after the run. However, the terminal pulse rate correlated much lower than this with the time of the run and does not make a good method for estimating fitness.

2. *Terminal Angle of the Progressive Pulse Ratio.* As a regular part of the Progressive Pulse Ratio, the angle between the 30 and 36/min. rates may be measured. If the person is a top athlete, the angle between the 36 and 40/min. rate should be used. In using the 40 step/min. step test on an all-out basis with athletes and former champions, it compares favorably with an all-out run on the treadmill at 10 miles per hour but in terms of oxygen intake values lies between the 7 and 10 mile per hour runs.

[35]Henry Montoye, "Interrelations of Maximum Pulse Rate During Moderate Exercise, Recovery Pulse Rate and Post Exercise," *The Research Quarterly*, 11:3-11, Oct. 1940.

*Figs. 25, 26 and 27 and accompanying cardiovascular data of Roger Bannister, Lauri Lehtinen and Marjorie Smith illustrate considerable contrasting levels of cardiovascular fitness. Bannister's cardiovascular records are superb, and as a whole, they illustrate records as fine as we have ever seen in any young man; the records of Lehtinen illustrate a world's champion who has deteriorated somewhat since he set the world's 5000-meter record and won the world's title in the 1952 Olympic Games in this event. His records are decidedly poorer than those of Roger Bannister, but beyond a doubt they would have been much better at the time that he won his world titles; the figure and data on Marjorie Smith indicate inferior cardiovascular responses, partly associated with a long period of inactivity and a touch of rheumatic fever. Data were taken after she had been in a rehabilitation program for almost a year. She was incapable of improvement to anything like the degree than an ordinary uncomplicated subject would have responded.

TABLE X

VALIDITY OF VARIOUS HEART SIZE, STROKE VOLUME, AND PULSE RATES AND WAVE MEASURES TO PREDICT THE ALL-OUT TREADMILL RUNNING TIME, 7 mi./hr./8.6%.

Variables and Tests	r	P.E.r	N
1. Area of Pulse Wave/Area of Frontal Diastolic X-Ray	0.568	0.094	24
2. Diastolic Surge of the Heartograph	0.588	0.093	24
3. Area of the Brachial Pulse Wave/Keys Heart Volume	0.528	0.104	24
4. Area Brachial Pulse Wave/Area of Body	0.477	0.111	24
5. Area of Brachial Pulse Wave	0.436	0.116	24
6. Liljestrand Heart Volume/Grollman Stroke Volume	0.209	0.138	24

3. *Post-Exercise Blood Pressures.* The blood pressures should be taken just one minute after the exertion. They are much more indicative of real capacity than the quiet blood pressures, especially the diastolic pressure which drops if the person is able to dilitate the small vessels sufficiently. This capacity is a very important one in our opinion; it indicates the warm-up capacity or adjustability to hard exercise. A trained young person can make a better adjustment and make it more quickly than an untrained one. The bearing of constitutional type has not been adequately investigated. There has long been the belief that the octo-mesomorph has better natural adaptability than the heavy mesomorph or the fat endomorph. Old age is partly viewed as inability to make an adjustment. However, many older athletes who have kept in training are still capable of great endurance, and hence, good circulatory adjustment.

4. *Brachial Pulse Wave/Area Frontal Diastolic Heart X-ray Area,* both in sq. cm., yields a fairly good indicator of functional efficiency. Considerable experimentation has been done with this index at Illinois by Cureton and his graduate students. After validating the index against Gross Oxygen Intake in the All-Out Treadmill Run at 10 mi./hr./8.6% grade, and finding validity coefficients much better than the other types of cardiovacular tests which combine blood pressure and pulse rate in the quiet state (0.70), it was decided to validate the various measures comparatively against the time of the 7 mi./hr./8.6% grade all-out treadmill run. This was carried out by Tosky[39] as a master's thesis. The results are shown in Table X.

No other measures were significant for predicting the time of the run; including the Transverse Diameter of the Heart Per Cent Deviation from the Ungerleider-Clark tables, Herxheimer's Heart Volume/Weight, Liljestrand's Heart Volume, Keys and Fridell's Heart Volume, Area of Frontal X-Ray, Transverse Diameter of the Heart.

Measurement of the heart X-Rays was by Levy's method[28]. The "ejection angle" of the heartograph taken as usual on the upper arm by the Cameron heartometer gave $0.477 \pm .111$ when correlated with treadmill run time.

It is interesting that these correlations are higher than we have been able to obtain for any measures of the ballistocardiogram or the electrocardiogram.

5. The T-Wave of the highest pre-cordial lead has some value on a simple quantitative basis. The data are curvilinear but Massey obtained etas as high as 0.55.

[39]R. F. Tosky, "Relationship of Heart Size to Treadmill Run," Urbana: M. S. Thesis (unpublished), Physical Education, Univ. of Illinois, 1951.

VA RESEARCHERS DISCOVER NEW FACTS ABOUT BODY FAT

Fat is not stored in the body as an inert padding but tends to produce more fat at a prodigious rate, a Veterans Administration research team has discovered. David D. Feller, Ph.D., and Elmer Feist, research assistant, of the VA hospital in Seattle, Wash., have found fat tissue converts blood sugar and other nourishment into fat at a much faster rate than do other tissues, VA said.

Dr. Feller and Mr. Feist incubated various mouse tissues in the laboratory and fed the tissues with compounds such as glucose, acetate, propionate, and methylmalonate, which are found in nearly all body cells. The compounds were "tagged" with radioactive materials so they could be traced through complex chemical reactions.

Mouse fat tissues in the laboratory dishes seemed to take up the raw materials on a "crash" basis, fashioning them into fat with great rapidity. Fat was produced more than 100 times as fast by fat as by tissues from the liver.

The studies, supported by a grant from the American Cancer Society, also indicated the chemical pathway by which fat builds fat differs from that used by other tissues. For example, fat makes fat out of acetate, a substance that other tissues convert to a variety of nonfat substances. The Seattle VA hospital researchers now are attempting to trace the steps in this process.

Dr. Feller, who is assistant chief of the hospital's radioisotope service and research assistant professor of medicine at the University of Washington School of Medicine, said findings from the project eventually may be helpful for weight control in humans. He said the information gained also may be the basis for further research on abnormal use of fats by the body, a condition associated with hardening of the arteries and many other diseases.

STUDIES IN PROGRESSIVE RESISTANCE EXERCISE: A REVIEW*

PHILIP J. RASCH, Ph.D., F.A.C.S.M.

In a series of earlier papers[1,2,3] the writer reviewed the literature relating to the use of progressive resistance exercise to develop muscular strength and hypertrophy. It is the purpose of this paper to bring together pertinent data which has been collected since publication of the earlier reviews.

Hellebrandt commented that "one of the unique features in the remedial exercise program of the military hospitals has been the broad application of the principles and practices of physical education to the treatment of medical and surgical conditions," and that the needs of military service have "served to focus attention upon the more purely biological effects of exercise and led to a rebirth of interest in these."[4] The biological effects, it has been emphasized, are extremely complex and include morphological, biophysical and physiological changes which probably take place concurrently during exercise.[5]

That changes occur in diseased muscle as a result of exercise was reported by DeLorme, Schwab and Watkins,[6] who observed that following acute anterior poliomyelitis the remaining innervated muscles responded to progressive resistance exercise by increasing in strength and work capacity in much the same manner as normal muscles; however, certain precautions should be observed in prescribing progressive resistance exercise for patients who have had muscular diseases. Krusen[7] stated that because muscles weakened by poliomyelitis fatigue quickly, programs of progressive resistance exercise must be modified. A "generalized neuromuscular exhaustion syndrome" may appear when poliomyelitis victims and certain other patients exercise at or near their maximum muscular strength, warned Knowlton and Bennett,[8] and Rudd[9] criticized exercise with maximal resistance as "inadvisable for some of the patients because of the danger of a muscle or ligament strain or an effusion into a joint."

Such warnings signal the need for caution and good judgment on the part of the physician prescribing progressive resistance exercises. However, the possibility of trauma to the average patient from overloading weak muscles seems remote. Luck observed that "no harm has been seen to result from pushing a weak muscle to its utmost against all the resistance it can overcome, and no evidence of minute hemorrhages or ruptured muscle fibers has been observed."[10] Klein,[11,12] observed consistently good results from the use of progressive resistance exercises in reducing the incidence of and in hastening recovery from injuries to the knees.

An important aspect of progressive resistance exercise is that it does not permit half-hearted performance. As Chepesuik[13] remarked, a person either lifts the weights or he does not; therefore, it is possible to insure exercise with maximum or near maximum effort. One of the difficulties that has continued to plague therapists is that of determining quickly and simply the amount of resistance necessary to obtain maximum or near maximum effort from a person. Various solutions to the problem have been pro-

*Report No. 15-57; The Research Center, The Los Angeles County Osteopathic Hospital, Los Angeles, California.

[1]Philip J. Rasch, and Richard V. Freeman, "The Physiology of progressive Resistance Exercise: A Review," *Journal of the Association for Physical and Mental Rehabilitation*, 8:35-41, March-April, 1954.

[2]Philip J. Rasch, "The Problem of Muscle Hypertrophy: A Review," *Journal of the American Osteopathic Association*, 54:525-528, May, 1955.

[3]Philip J. Rasch and Richard V. Freeman, "The Role of Weight Training in a Neuropsychiatric Hospital," *The British Journal of Physical Medicine*, 19:153-158, July, 1956.

[4]F. A. Hellebrandt, "Recent Advances in Methods of Hastening Convalescence through Exercise," *Southern Medical Journal*, 39:397-401, May, 1946.

[5]Sara Jane Houtz, Annie M. Parrish and F. A. Hellebrandt, "The Influence of Heavy Resistance Exercise on Strength," *Physiotherapy Review*, 26:299-304, November-December, 1946.

[6]Thomas L. DeLorme, Robert S. Schwab and Arthur L. Watkins, "The Response of the Quadriceps Femoris to Progressive Resistance Exercises in Poliomyelitic Patients," *Journal of Bone and Joint Surgery*, 30-A:834-847, October, 1948.

[7]Edward M. Krusen, "Functional Improvement Produced by Resistive Exercise of Quadriceps Muscles Affected by Poliomyelitis," *Archives of Physical Medicine*, 30:271-277, May, 1949.

[8]G. Knowlton, Clinton Bennett and Robert L. Bennett, "Overwork," *Archives of Physical Medicine and Rehabilitation*, 38:18-20, January, 1957.

[9]J. L. Rudd, "Resistance Exercises in Private Practice," *Archives of Physical Medicine and Rehabilitation*, 36:775-778, December, 1955.

[10]J. Vernon Luck, "Orthopedic Rehabilitation," *Air Surgeon's Bulletin*, 2:431-433, December, 1945.

[11]Karl K. Klein, "Progressive Resistance Exercise and Its Utilization in the Recovery Period Following Knee Injury," *Journal of the Association for Physical and Mental Rehabilitation*, 10:94-98, May-June, 1956.

[12]Karl K. Klein, "Specific Progressive Exercise as a Mass Technique for Preventive Conditioning and Reduction of Knee Injury Potential in Athletics," *Journal of the Association for Physical and Mental Rehabilitation*, 10:185-188, November-December, 1956.

[13]Maurice W. Chepesuik, "Progressive Heavy Resistance Exercises for the Forefoot and Lower Limb," *Canadian Medical Association Journal*, 72:108-111, January 15, 1955.

posed by Klein and Johnson,[14] Clark and Herman[15] and Rasch,[16] but there appears to be no data in the literature concerning the methods considered most useful by therapists in the field.

It seems unlikely that increases in strength and hypertrophy represent the total beneficial effects of progressive resistance exercise; but, because difficulties have been encountered in studies of this type, few reports pertaining to this question are contained in the literature. Pointing out that elevations of 8 to 10° F. in skin temperature have frequently been observed in an exercised muscle, Rose[17] implied that the flow of blood to the working muscles is increased during exercise, with resultant diminution in capsular and intramuscular fibrosis. Pursuing this same line of inquiry, O'Connell[18] demonstrated that local passive heating of a muscle does not affect its strength as measured by a single maximum isometric contraction. Clark and his associates,[19] reported that laboratory tests disclosed retention of nitrogen and phosphorus following exhaustive progressive resistance exercises by two subjects with rheumatoid arthritis. One subject retained calcium also.

Biochemical analyses of the muscular tissues of rats confined to small individual cages and of rats confined to activity cages by McClintock, Hines and Jordan[20] disclosed that the water content of the skeletal muscle was essentially the same for both groups of animals. Likewise, no significant differences were noted in nitrogen content or creatine concentration; however, values for extractable muscle pigment (hemoglobin) were consistently higher for the active animals. Bach,[21] who suggested that activity may convert red muscle into pale muscle, severed the tendon of the soleus muscle of a rabbit and sutured it to the synergistic pale tibialis posterior muscle. After two weeks, the transplanted soleus muscle exhibited a reflexly induced tetanic contraction more characteristic of pale muscle than of red muscle. Both the iron and the myohemoglobin content in the transplanted soleus muscle were far below normal. In general, however, there seems to be little reason to disagree with Maison and Broeker's verdict that "biochemical studies devoted to measuring changes in constituents of muscle as a result of training have not been very illuminating."[22]

In recent years there has been increasing emphasis on the role of the central nervous system in the development of strength by means of progressive resistance excercise. Knowlton suggested that "physiologically, conditioning can be considered as establishing a spectrum of neuron thresholds which will yield a reliable temporal pattern of recruitment and inhibition for effector excitation." He viewed patterns of movement as conditioned responses involving a detector-integrator-effector system and asserted that such patterns demand a certain minimal strength of each muscle involved. It is highly probable, said Knowlton, that exercises required to develop muscular strength, that is, graded and near maximal resistance exercises, also help "to bring some of the high threshold neurons within the orbit of voluntary activity."[23]

Kabat stated that all therapeutic exercise is based on a few simple principles of the physiology of neuromuscular mechanisms. Among these are the following:

1. Improvement in function results from frequent and strong excitation of the nervous pathway from the brain to a muscle.
2. Continued activity is necessary to sustain power, endurance and coordination.
3. The establishment of new patterns of motion is dependent upon successful repetitions of an activity.
4. The quality of activity in a muscle depends primarily upon the proportionate number of motor units excited.

> From these principles, [wrote Kabat] it follows that for the most effective neuromuscular reeducation, treatments should employ a maximal quantity of activity, which is induced by maximal voluntary effort repeated the maximal number of times. . . . Heavy resistance exercise is the most effective method of activating the greatest number of motor units and of producing maximal activation of the entire pathway.[24]

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[14]Karl K. Klein and Elden Johnson, "Research: A Method of Determining the Maximum Load, for Ten Repetitions, in Progressive Resistance Exercises for Quadriceps Development." *Journal of the Association for Physical and Mental Rehabilitation*, 7:130-131, July-August, 1953.

[15]David H. Clarke and Edward L. Herman, "Objective Determination of Resistance Load for Ten Repetitions Maximum for Quadriceps Development," *Research Quarterly*, 26:385-390, December, 1955.

[16]Philip J. Rasch, "Relationship Between Maximum Isometric Tension and Maximum Isotonic Elbow Flexion," *Research Quarterly*, 28:85, March, 1957.

[17]Donald Rose, discussing Dorothy G. Hoag, "Physical Therapy in Orthopedics, With Special Reference to Heavy Resistance, Low Repetition Exercise Program," *Physiotherapy Review*, 26:291-294, November-December, 1946.

[18]Eugene R. O'Connell, "A Physiological Study of Muscular Strength," Unpublished Master's Thesis, University of California, Los Angeles, June, 1956.

[19]William S. Clark, Arthur L. Watkins, Henrick O. Tonning and Walter Bauer, "The Effects of Resistance Exercises on Nitrogen, Phosphorous and Calcium Metabolism of Patients with Rheumatoid Arthritis," *Journal of Clinical Investigation*, 33:505-509, April, 1954.

[20]J. T. McClintock, H. M. Hines and Dorothy P. Jordan, "Effects of Activity upon Tissues of the Rat," *Proceedings of the Society for Experimental Biology and Medicine*, 42:139-142, October, 1939.

[21]L. M. N. Bach, "Conversion of Red Muscle to Pale Muscle," *Proceedings of the Society for Experimental Biology and Medicine*, 67:268-269, March, 1948.

[22]G. L. Maison and A. G. Broeker, "Training in Human Muscles Working With and Without Blood Supply," *American Journal of Physiology*, 132:390-404, March, 1941.

[23]G. Clinton Knowlton, "Physiological Background for Neuromuscular Reeducation and Coordination," *Archives of Physical Medicine and Rehaiblitation*, 35:635-636, October, 1954.

These statements should not be interpreted to mean that a patient in need of neuromuscular reeducation should be placed immediately on a program of heavy resistance exercises requiring maximal effort. The necessity of his first learning to perform movements correctly was emphasized by Lundervold,[25] who observed in an electromyographic study of training and fatigue that during the training period a movement must be performed repeatedly with less than maximal tension until it can be executed perfectly; subsequently, maximal contractions are necessary to condition all the fibers of the muscle.

Knowledge of the physiological basis underlying progressive resistance exercise was advanced by studies of the overload principle by Hellebrandt and Houtz,[26] who, after four years of research, arrived at the following conclusions:

1. Strength and endurance increase as a result of progressive resistance exercise.
2. The slope gradient of the training curve varies with the magnitude of the stress imposed, the frequency of practice sessions and the duration of the overload effort.
3. Repetition of movements which do not cause neuromuscular stress have little effect on the functional capacity of skeletal muscle.
4. The amount of work done per unit of time is the critical variable upon which improvement in performance depends.
5. Changes in the central nervous system appear to be an important effect of training.
6. The ability to develop maximal tension appears to be dependent on the proprioceptive facilitation with which overloading is associated.
7. The foregoing conclusions do not shed any light on the respective values of the different systems of exercise which have been recommended in the literature.

In general, these conclusions have been confirmed by other investigators in the field. The superiority of progressive resistance exercises for the development of strength and hypertrophy was demonstrated by Montgomery.[27] Her subjects were ten girls, who trained for six weeks by performing rapid exercises with one arm without a weight and slow exercises with the other arm with a weight. The mean girth of the limbs exercised with weights increased 0.30 inch; the mean girth of the arms exercised without weights increased 0.2375 inch. The mean gain in endurance, as measured by a subject's ability to lift a ten pound dumbbell as many times as possible, was fifteen lifts for the arms exercised with weights and 11.3 lifts for the arms exercised without weights. The possible effects of cross education were not evaluated in this study.

Studies by Maison and Broeker,[22] Rasch[28] and others tend to substantiate the importance of the role of the central nervous system in strengthening the muscles, but Darcus[29] concluded that we can only hypothesize at the present time as to the optimum method of improving muscular function, and that perhaps too much emphasis has been placed on function and not enough on the neuromuscular changes induced by exercise.

A review by Salter[30] served to emphasize the lack of knowledge of the comparative results of the various systems of progressive resistance exercises recommended by authorities. However, a few studies on this question have been reported in the literature.

Basing his recommendtaions on a questionnaire submitted to seventeen finalists in the "Mr. Britain" contest in 1953 to select the best male physique, MacQueen[31] advised sets of heavy resistance exercises of few repetitions for increasing muscular hypertrophy and sets of decreasing repetitions and increasing resistance for developing strength. A more scientific approach to the problem was taken by McMorris and Elkins,[32] who prescribed a light and heavy system of exercise for one group of subjects and a heavy and light system for a second group of subjects. With ten repetitions as the maximum in a set, the heavy and light system produced an increase 5.5 per cent greater than that produced by the light and heavy system. The statistical significance of this difference was not stated by the investigators; however, their findings regarding the superiority of the heavy and light system of exercise appear to concur with the common experience of weight trainers. It is interesting that the heavy and light system of exercise was criticized on theoretical grounds by Hellebrandt and Houtz, who contended that to reduce the stress on the muscles is a violation of the fundamental concept on which overload training is based. "Determination not to reduce the rate of working when the stress imposed

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[24]Herman Kabat, "Studies on Neuromuscular Dysfunction. XI: New Principles of Neuromuscular Reeducation," *Permanente Foundation Medical Bulletin*, 5:111-123, November, 1947.

[25]Arne Lundervold, "Electromyographic Investigation in Training and Fatigue," *Sport and Health*, Otto Johansen, Editor. Oslo: Royal Norwegian Ministry of Education, 1952, p. 84.

[26]F. A. Hellebrandt and Sara Jane Houtz, "Mechanisms of Muscle Training in Man," *Physical Therapy Review*, 36:371-383, June, 1956.

[27]Allene Montgomery, "Muscular Hypertrophy Following Various Exercise Regimes," Unpublished paper, University of Southern California, June, 1954.

[28]Philip John Rasch, "Effects of Unilateral Progressive Resistance Exercises on the Contralateral Limb," Unpublished Doctoral Dissertation, University of Southern California, June, 1956.

[29]H. D. Darcus, in "Discussion on Evaluation of the Methods of Increasing Muscle Strength," *Proceedings of the Royal Society of Medicine*, 49:999-1006, December, 1956.

[30]Nancy Salter, "Exercise Therapy," *Annals of Physical Medicine*, 4:81-93, August, 1957.

[31]I. J. MacQueen, "Recent Advances in the Technique of Progressive Resistance Exercise," *British Medical Journal*, 4898:1193-1198, November 20, 1954.

[32]Rex O. McMorris and Earl C. Elkins, "A Study of Production and Evaluation of Muscular Hypertrophy," *Archives of Physical Medicine and Rehabilitation*, 35:421-426, July, 1954.

seems insuperable," they wrote, "is the *sine qua non* of overload training."[26]

Capen[33] experimented with the following four basically different programs of progressive resistance exercise to determine the relative merits of each for the development of muscular strength:

1. Eight to fifteen lifts of maximum weight in one set.
2. Eight to fifteen lifts of maximum weight in one set plus five lifts of maximum weight in one set.
3. Five lifts of maximum weight in three sets.
4. One lift of maximum weight, repeated three times.

From his results Capen concluded that the third program was superior to the other three and that a regimen consisting of exercise three times a week produced more satisfactory results than one requiring exercise five times weekly.

The system of progressive resistance exercises most widely used in physical medicine and rehabilitation centers is probably that advocated by DeLorme.[34,35] In employing this system the therapist first ascertains the amount of weight that a patient can lift for ten repetitions. Exercises are performed in three sets of ten repetitions: in the first set a weight equal to one-half the maximum weight lifted for ten repetitions is utilized; in the second set, a weight equal to three-fourths of the maximum weight lifted for ten repetitions; and in the third set, a weight equal to the maximum lifted for ten repetitions. Rudd[8] advocated exercise with moderate weights for a moderate number of repetitions for patients unable to exercise with maximum resistance.

Although recognizing the value of DeLorme's method of employing the lightest weight during the "warming up" process, McCloy considered the possibility of producing muscular hypertrophy more quickly by means of a system of exercise utilizing the heaviest weight that could be lifted by an individual for a given number of repetitions. Tests of this method were conducted by Henry[36] and by Faulkner.[37] Henry exercised the flexor muscles of his left arm and the extensor muscles of his right leg by the DeLorme system and the muscles of his right arm and of his left leg by another method, which consisted of his lifting the maximum weight for ten repetitions in the first set, the same weight as many times as possible in the second set, and three-fourths of this weight as many times as possible in the third set. A three-minute rest period was observed between sets. The results produced by the two methods of exercise were comparable at the end of an eight weeks' regimen. Faulkner used the DeLorme system for exercising the flexor muscles of the right arm and the extensor muscles of the left leg. He exercised the opposite limbs by a different system, designated the McCloy method, which in the first set required one-half the maximum weight lifted for ten repetitions, in the second set the maximum weight lifted for ten repetions, and in the third set, three-fourths of the maximum weight lifted for ten repetitions. Faulkner's results showed that the DeLorme system produced a greater increase in strength than the McCloy method (154 per cent to 142.5 per cent), but that the latter developed greater endurance (212.8 per cent to 186 per cent). The effects of cross education were not evaluated.

It is interesting to note that to date physiatrists have been unable to improve substantially on the techniques of training developed by weight trainers through trial and error. McGovern and Luscombe[38] reported that patients who have had poliomyelitis fatigue so rapidly during exercise that even though they can lift the weight determined to be maximal for ten repetitions, they are unable to complete thirty repetitions, as prescribed in the DeLorme method. This phenomenon, they postulated, was related to a low "fatigue threshold" rather than to weakness of the muscles involved. More satisfactory results were obtained when the order of exercise was reversed, that is, exercise utilizing the maximum weight first, with three-fourths of the maximum weight next, and with one-half the maximum weight last. Similar methods have been publicized in Great Britain as the Zinovieff or Oxford technique;[39] however, these routines, commonly referred to as the "heavy and light system," have been utilized by weight trainers for decades.

A previous review[1] cited the general principle advanced by Manzer that short, frequent rests resulted in greater efficiency in muscular work than did prolonged, infrequent rests. Mueller,[40] in analyzing the physiological basis of rest pauses, stated that during work muscular contraction is followed by relaxation. Physiologically, during contraction the blood is forced

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[33]Edward K. Capen, "Study of Four Programs of Heavy Resistance Exercises for Development of Muscular Strength," *Research Quarterly*, 27:132-142, May, 1956.

[34]Thomas L. DeLorme and Arthur L. Watkins, *Progressive Resistance Exercise*. New York: Appleton-Century-Crofts, Inc., 1951, p. 24.

[35]C. DeWitt Dawson, "An Intensive Exercise Program for Use in Knee Surgery and Pathology," *Archives of Physical Medicine and Surgery*, 34:750-755, December, 1953.

[36]Clayton Gene Henry, "A Comparison of the Effectiveness of Two Methods of Exercise for the Development of Muscular Strength," Unpublished Master's Thesis, State University of Iowa, Iowa City, August, 1949.

[37]Everett Winston Faulkner, "A Comparison of the Effectiveness of Two Methods of Exercise for the Development of Muscular Strength," Unpublished Master's Thesis, State University of Iowa, Iowa City, February, 1950.

[38]Richard E. McGovern and Harold B. Luscombe, "Useful Modifications of Progressive Resistive Exercise Techniques," *Archives of Physical Medicine and Rehabilitation*, 34:475-477, August, 1953.

[39]A. N. Zinovieff, "Heavy Resistance Exercises, The Oxford Technique," *British Journal of Physical Medicine*, 14:129-132, June, 1951.

out of the muscle into the veins; conversely, during relaxation arterial blood is propelled into the empty vessels by blood pressure. Thus, the rhythmic activity of each muscle acts as an accessory pump which assists the heart in circulating the blood. The greater the flow of blood through a muscle during contraction and relaxation, the more rapid is recovery from fatigue. Experiments with a bicycle-ergometer demonstarted that frequent, brief tests relieve fatigue more effectively than infrequent, prolonged rests; moreover, that during the rest intervals there must be complete cessation of activity, for movement delays recovery.

Some indication of the optimum rest pause was given by Clarke, Shay and Mathews,[41] who reported that following exhaustive exercise of the muscles which flex the elbow there was a pronounced loss in strength (31 per cent) still evident after 30 seconds of rest. After a rest pause of 2.5 minutes, the loss in strength was 18 per cent; and at the end of 7.5 minutes, the decline was 13 per cent, which decreased very gradually thereafter to 5 per cent at the end of 42.5 minutes.

Payne and Hauty demonstrated recently that rest pauses are equally important in preventing loss of efficiency in skilled performance. They suggested that rest pauses may be considered as exerting "homeostatic influences which, if optimalized, preclude for all practical purposes the cumulative decremental effects of repeated reactions."[42]

Other investigators have studied the relationship between respiration and physical performance. Starr, Mayock and Battles,[43] whose subjects performed supine presses with a 10 pound weight, calculated the mechanical efficiency of the healthy subjects to be 12.7 per cent and that of the postoperative subjects 9.6 per cent. In both groups of subjects they observed a more efficient performance when mechanical work was preceded by deep breathing, although a high degree of day to day variation was noted. Later, after devising a mechanical method of estimating work, Starr[44] concluded that the earlier data specifying the muscular efficiency of weight lifters were about 10 per cent too low.

Wayne's advice that a weight lifter should exhale during effort to decrease intra-abdominal tension and relax "antagonistic" muscles[45] supporting the basic rule advanced earlier by Lipovetz[46] that a weight lifter should exhale with compression of the thorax and inhale with expansion of the thorax. Although Wayne stated that this rule is well known to professional weight lifters, it is not generally accepted by writers in this country. Both Edwards[47] and Hoffman[48] recommended inhalation during peak exertion and exhalation as the weight is lowered to attain maximum results.

That increases in endurance and in hypertrophy do not appear simultaneously and may be unrelated phenomena was observed by Maison and Broeker,[32] whose observation was confirmed more recently by McMorris and Elkins.[33] The latter investigators reported a correlation of r = .17 between increases in circumference and increases in strength of the right arm. Likewise, Rasch and Morehouse[49] reported that increases in girth correlated with increases in strength, r = .422.

Maison and Broeker postulated that hypertrophy may be a by-product of training, perhaps a noxious one. Although this theory does not seems to have been explored, DeLorme, West and Schreiber[50] cast some doubt on the idea by their statement that frequently patients who have regained normal muscular strength but lack normal girth seem to lose their strength more rapidly than those who have regained normal muscular girth. This raises the question of whether the discontinuation of therapeutic exercises prior to restoration of normal girth is advisable.

DeLorme, Ferris and Gallagher,[51] recognizing the possibility that an increase in muscular hypertrophy may be accompanied by changes in viscosity and alterations in contraction time, compared contraction times for two small groups of adolescent boys. Only one group practiced progressive resistance exercises for the elbow flexors and knee extensors for a period of four months. A comparison of the two groups at the end

[40]E. A. Mueller, "The Physiological Basis of Rest Pauses in Heavy Work," *Quarterly Journal of Experimental Physiology and Cognate Medical Sciences.* 38:205-215, October, 1953.

[41]H. Harrison Clarke, Clayton T. Shay and Donald K. Mathews, "Strength Decrements of Elbow Flexor Muscles Following Exhaustive Exercise," *Archives of Physical Medicine and Rehabilitation,* 35:560-561, September, 1954.

[42]Robert B. Payne and George T. Hauty, "Skill Fatigue as a Function of Work-Rest Distribution," *Report No. 57-140.* Air University, School of Aviation Medicine, U.S.A.F., July, 1957.

[43]Isaac Starr, Robert L. Mayock and Marjorie G. Battles, "Studies of Various Physiological Responses to a Mild Exercise Test," *American Journal of the Medical Sciences,* 210:713-725, December, 1945.

[44]Isaac Starr, "Units for the Expression of Both Static and Dynamic Work Load in Similar Terms, and Their Application to Weight Lifting Experiments," *Journal of Applied Physiology,* 4:21-29, July, 1951.

[45]N. D. Wayne, "Weight Lifting," *British Medical Journal,* 4870:1098, May 8, 1954.

[46]Ferd John Lipovetz, *"Basic Kinesiology,"* Minneapolis: Burgess Publishing Company, 1952, p. 48.

[47]Robert W. Edwards, "Developing a Weight-Lifting Training Program," *The Physical Educator,* 2:24-25, October, 1941.

[48]Bob Hoffman, "Advanced Methods of Weight Training," *Strength and Health,* November, 1957, p. 31.

[49]Philip J. Rasch and Laurence E. Morehouse, "Effect of Static and Dynamic Exercises on Muscular Strength and Hypertrophy," *Journal of Applied Physiology,* 11:29-34, July, 1957.

[50]Thomas L. DeLorme, Francis E. West and William J. Schreiber, "Influence of Progressive-Resistance Exercises on Knee Function Following Femoral Fractures," *Journal of Bone and Joint Surgery,* 32A:910-924, October, 1950.

of that time showed no significant changes in the contraction times of the exercised muscles. This is consistent with Leighton's statement that the weight lifters whom he had observed showed a high degree of flexibility.[52]

The duration of the benefits derived from progressive resistance exercise was investigated by Gallagher and DeLorme,[53] who studied the progress of seventeen boys with patellar injuries, for which progressive resistance exercise had been prescribed. Subsequent observation two to twelve months following discontinuation of the exercise regimen failed to reveal changes in any of the seventeen patients to indicate that the benefits had been lost. Jones[54] compared the physical fitness of subjects at the end of a weight training program of six and one-half weeks' duration with their condition eight weeks after cessation of training and concluded that the improvement in physical fitness resulting from this form of exercise persisted at least for the duration of the post-exercise period. However, in a similar study by McMorris and Elkins [32] tests at the end of one year showed a mean loss of 55 per cent in strength and 56 per cent in hypertrophy gained during a program of progressive resistance exercises.

The physiological data from studies of weight lifters have been conveniently summarized by Counsilman.[55] In this review he stated that weight lifters were above average in tests of flexibility, agility, coordination, power, strength and physical fitness, although there was some evidence that former weight lifters tend to become less flexible than the average middle-aged man; that the mean systolic and diastolic blood pressures were slightly elevated; and that diastolic pressures were relatively higher than systolic pressures. This author also pointed out that a lift of maximum weight increased the blood pressure far more than other types of strenuous exercise, and that such marked elevations in blood pressure may be potentially dangerous, particularly for middle-aged and elderly persons.

Conclusions

The foregoing review of the scientific literature relating to progressive resistance exercise suggests the following conclusions:

1. Treatment by means of progressive resistance exercise offers a valuable addition to the armamentarium of physicians and therapists concerned with the development or restoration of muscular strength and hypertrophy.

2. Regimens of progressive resistance exercise are largely empirical, and little information is available concerning the relative advantages of the various programs which authorities have recommended.

3. The success of an exercise regimen appears to depend primarily upon the ability of the therapist to inspire the patient to exert his maximum efforts.

4. The physiological mechanism by which muscular strength and hypertrophy are increased and the relationship between changes in these attributes is not clear.

5. There is no evidence that undesirable neuromuscular effects result from progressive resistance exercises; nevertheless, because exercise with maximum resistance produces marked elevations in blood pressure, such exercise may be inadvisable for certain individuals, particularly for those of middle age or older.

[51]Thomas L. DeLorme, Benjamin G. Ferris and J. Roswell Gallagher, "Effect of Progressive Resistance Exercise on Muscle Contraction Time," *Archives of Physical Medicine*, 33:86-92, February, 1952.

[52]Jack R. Leighton, "Flexibility Characteristics of Three Specialized Skill Groups of Champion Athletes," *Archives of Physical Medicine and Rehabilitation*, 38:580-583, September, 1957.

[53]J. R. Gallagher and T. L. DeLorme, "The Use of the Technique of Progressive Resistance Exercise in Adolescence," *Journal of Bone and Joint Surgery*, 31A:847-858, October, 1949.

[54]Frank Burton Jones, "An Investigation of the Persistence of Physiological Condition after Cessation of Exercise Regimes," Unpublished Doctoral Dissertation, University of Southern California, Los Angeles, August, 1951.

[55]James E. Counsilman, "Does Weight Training Belong in the Program?" *Journal of Health-Physical Education-Recreation*, 26:17 *et seq.*, January, 1955.

NEW DRUG SPEEDS HEALING PROCESS

Successful use of a new drug product to reduce swelling and speed healing of injuries and infections has been reported by Veterans Administration. Streptokinase-streptodornase, in tablet form, was given to 57 patients with conditions involving abscess, swelling, and blood clots, a research group at the Fort Howard, Md., VA hospital said. The researchers, Dr. Joseph M. Miller, Dr. George C. Godfrey, Dr. Milton Ginsberg, and Dr. Constantine J. Papastrat, said results were excellent in most cases.

Some improvement in inflammation and swelling was observed within 24 hours after the drug was administered, and preventive use of the tablets permits surgical repair of extensive wounds with only a fraction of the swelling that normally occurs.

The doctors said the new tablet form of streptokinase-streptodornase also eliminates the pain and annoyance that some patients experience from injections of the drug. The tablets are allowed to dissolve in the patient's mouth next to the cheek, with absorption taking place through the cheek membranes.

Since the drug mechanism permits passage of bacteria from the site of an infection to other parts of the body, the Fort Howard surgeons said it is essential that patients suspected of having an infection be treated with an antibiotic at the same time they receive the tablets, as was done in the VA study. The doctors reported their findings in a recent issue of the *Journal of the American Medical Association*.

THE LONG-TERM CONTINUING CARE PATIENT*

LEO ROSENBERG, M.D. **

In a previous paper on this subject, it was pointed out that the VA must now prepare to adequately care for an increasingly large aged and chronically ill veteran population. Focusing attention on this group serves to alert medical and administrative leaders to the problems involved and stimulate anticipatory efforts to establish facilities and programs to meet the challenge as efficiently as possible.

The National Conference on the care of the long-term patient defines long-term patients as "those persons suffering from chronic disease or impairments who will require a long period of care, that is, who are likely to need or have received care for a continuous period of at least 30 days in a general hospital; or care for a continuous period of more than three months in another institution or at home." Based on this definition the VA IB 10-110, August 30, 1957 states that "on November 30, 1954, more than two-thirds of our hospitalized veterans had been in hospitals over 90 days; 40% more than one year; 38% more than three years." The effect of the aging veteran population on the demand for hospitalization is vividly revealed by the fact that, at present, approximately 16% of the veteran population is over 55 years of age, while 36% of veterans in VA hospitals are over 55."

On November 19, 1957, three years later, a survey taken at this hospital (Kennedy) showed that out of a total of 1069 non-tuberculosis patients, 454 were above 55 years of age — 42.4%. The total breakdown of age groups in the hospital at that date is given in Table I.

Admission to and length of hospitalization stay frequently result from a continuation of social as well as medical factors. Although many patients are admitted because of specific medical needs only, a good many seek admission or remain in the hospital for socio-economic and psychological reasons as well. Often medical needs are overshadowed by the need for physical or psychological shelter. Many persons who no longer need general hospital care but do need aid and attendance must be kept in the hospital at public expense because of difficulties in finding a suitable place for service at a reasonable cost.

Unnecessary hospitalization results in diminution of resources and services for those who urgently need the specialized services of the general hospital. It aggravates the shortage of beds and raises a serious staffing problem of hospital personnel of whom there is already a great shortage.

*Presented Dec. 6, 1957 at VA Area PM&R Conference at Medical Teaching Group Hospital, Memphis, Tennessee

**Chief, Physical Medicine and Rehabilitation Service, VA Medical Teaching Group Hospital, Memphis, Tennessee

Number of Non-TB Patients in VAMTG Hospital, Memphis, Tenn., on Nov. 19, 1957

Age Group	No.	3-6 Mos.	6 Mos.-Over	Months over 6 Mos.	No. of Patients
20-24 incl.	42	9	9	6-12	64
25-29 incl.	69	12	11	13-18	21
30-34 incl.	103	21	15	19-24	8
35-39 incl.	155	20	11	25-30	3
40-45 incl.	118	20	13	31-36	6
45-49 incl.	84	11	7	37-42	1
50-54 incl.	44	8	5	43-43	1
55-59 incl.	38	9	6	49-54	1
60-64 incl.	229	28	15	55-60	
65-69 incl.	133	20	9	61-66	
70-74 incl.	30		5	67-72	
75-79 incl.	11		4	73-78	1
80 or over	13	5	2	79-84	3
				85-over	3
	1069	163	112		112

Total—1069 Non-TB patients
Total over 55—454—42.4% of total
Between 60-69—362—33.8% of total

Total hospitalized over 3 Mos.—285
Percentage of total—26.5%

TABLE I

Equally important is the impact of prolonged hospitalization on the patient, his relationship with his family and the community, and his ability to readjust to the life in the community upon his return.

Despite absence of need for continued active treatment, many patients are dependent on continued institutional care. The main reasons for such care are:

1) Unsuitability of the patient's home.
2) Non-acceptance of the patient by his family.
3) Lack of other facilities and services such as institutions for long-term care of the sick, home-like institutions for those who need shelter and aid, and organized programs of home care.

Further analysis of our 1069 non-TB patients showed some other facts which are interesting. We found 285 patients, or 26.5%, who had been hospitalized over 90 days. Of these, 112 or a little over 39%, had been in six months or longer. Of these 112 patients, 30 were between ages 55 and 70, about 26.5%. Another interesting observation is that out of the total of 285, 100 patients are between the ages of 30 and 45. This is about 35%. Of this group the division is 61%, 3 months to 6 months, and 39%, above 6 months. The paraplegic and quadriplegic group in this category and the respiratory group diseases together total 170 or 59.6%. (Table II).

TABLE II

Principal Disability Group	No. of Patients
Arteriosclerosis	8
Surgery	23
Arthritis	6
Cardiac	9
CNS Disease	1
Hemiplegia	12
Malignancy	16
Paraplegia, Quadriplegia and Polio	84
Psychiatric	7
Orthopedic	10
Respiratory	86
Urologic	5
Miscellaneous (includes Diabetes, Cirrohis of liver, Syphilis, etc.)	18
Total	285

Adequate hospital care of long-term continuing care patients has been emphasized repeatedly by many writers as well as by Dr. Middleton, our Chief Medical Director. Such care includes:

1) Proper distribution of patients throughout the hospital in such areas where they can best be handled. Separate VA hospitals for chronically long-term patients are not considered feasible.
2) Acceptance by hospital administrators and medical directors that the problems of long-term continuing care are with us and will continue to remain with us, and that all medical and surgical programs in the hospital must be re-oriented to adequately encompass these problems.
3) Sufficient medical and surgical attention to meet the increasing needs of this group. Because of the severe chronic disabilities already present, the difficulty of bringing about improvement in the presence of debilitation, and the increased susceptibility of such patients to complicating disabilities, such care is required in large amount. Consider, for example, the number of nursing aides, and practical nurses needed on each shift to take care of the beds, hygiene and cleanliness of the patients. Consider the number of medications which must be distributed daily, either every 3 hours, 4 hours, or t.i.d. Consider the number of dressings, the catheterizations, the oxygen tents, and it become obvious that wherever such patients are present in any significant number that the cost of upkeep and care will mount.

But the economic aid alone will not meet the situation. Specially trained personnel strongly motivated by humanitarian feelings, nurses and nursing assistants with considerable initiative and dependability, all working together with the doctors as a team and assisted by dietitians, psychologists, PM&R therapists, chaplains, social workers, Special Service, volunteers and aides are necessary. It is important in this effort not to forget the patient himself.

Motivation of the patient is a fundamental necessity both as to physical maintenance and further rehabilitation. Lack of motivation may be due to: a) indifference on the part of the family, b) insecurity, unhappiness and loneliness on the part of the patient, c) fear of activity, engendered by lack of knowledge, explanation or exposure to the techniques of rehabilitation, d) fear of ultimate transfer from hospital to other environment. These are the areas in which the team approach can be most successful.

But even after a patient has been motivated, it becomes essential to determine his functional capacity within the limitations of his physical tolerance. In response to the recommendation of the National Conference on The Care of the Long Term Patient, for a simple and effective inter-agency referral system, a systemic classification, based on The Pulhem's Profile method used by the U. S. Army has been devised at Grasslands Hospital, Valhalla, N. Y. and by the Dept. of Physical Medicine and Rehabilitation, New York University, Bellevue Medical Center. (Table III).

Essentially it is divided into six sections spelling out the word PULSES. Each section is then subdivided again into four subheadings, representing – 1.) No

PHYSICAL PROFILE*

P. Physical condition including diseases of the viscera (cardiovascular, pulmonary, gastrointestinal, urologic, and endocrine) and cerebral disorders which are not enumerated in the lettered categories below.

1. No gross abnormalities considering the age of the individual.
2. Minor abnormalities not requiring frequent medical or nursing supervision.
3. Moderately severe abnormalities requiring frequent medical or nursing supervision yet still permitting ambulation.
4. Severe abnormalities requiring constant medical or nursing supervision confining individual to bed or wheelchair.

U. Upper extremities including shoulder girdle, cervical and upper dorsal spine.

1. No gross abnormalities considering the age of the individual.
2. Minor abnormalities with fairly good range of motion and function.
3. Moderately severe abnormalities but permitting the performance of daily needs to a limited extent.
4. Severe abnormalities requiring constant nursing care.

L. Lower extremities including the pelvis, lower dorsal and lumbosacral spine.

1. No gross abnormalities considering the age of the individual.
2. Minor abnormalities with fairly good range of motion and function.
3. Moderately severe abnormalities permitting limited ambulation.
4. Severe abnormalities confining the individual to bed or wheelchair.

S. Sensory components relating to speech, vision, and hearing.

1. No gross abnormalities considering the age of the individual.
2. Minor deviations insufficient to cause any appreciable functional impairment.
3. Moderate deviations sufficient to cause appreciable functional impairment.
4. Severe deviations causing complete loss of hearing, vision or speech.

E. Excretory function, i.e., bowel and bladder control.

1. Complete control.
2. Occasional stress incontinuence or nocturia.
3. Periodic bowel and bladder incontinence or retention alternating with control.
4. Total incontinence, either bowel or bladder.

S. Mental and Emotional Status.

1. No deviations considering the age of the individual.
2. Minor deviations in mood, temperament and personality not impairing environmental adjustment.
3. Moderately severe variations requiring some supervision.
4. Severe variations requiring complete supervision.

PROFILE

P U L S E S

*Reprinted from Eugene Moskowitz and Cairbre B. McCann, "Classification of Disability in the Chronically Ill and Aging, *Journal of Chronic Diseases* 5:3:343, March, 1957, with permission of the publishers, C. V. Mosby Co., St. Louis.

TABLE III

gross abnormalties; 2.) Minor abnormalties; 3.) Moderately severe abnormalities; 4.) Severe abnormalities.

Acceptance of such profile grading might be of considerable value in determining the necessity for further prolonged hospitalization or consideration of adequate post-hospital planning.

SUMMARY:

Evidence has been presented that planning for an increasing number of long-term continuing care patient groups is essential. A general scheme of management by group leaders acting in concert and yet having personal responsibility is given. A system of profile grading for use by intra-service agencies to make reporting, evaluation and planning for long-term continuing care patients as recommended by the New York University, Bellevue Hospital group is brought to your attention for consideration.

Cont'd on Pg. 137

THE REHABILITATION PROGRAM AT CAMP AMERICAN LEGION (Wisc.)

LESLIE M. ROOT, C.C.T. **

Introduction

Camp American Legion Rehabilitation Center was established in 1925 by the Department of Wisconsin, American Legion, with a state grant, on a lease basis together with the Conservation Commission of the State of Wisconsin. The camp is located on Little Tomahawk and Big Carr Lakes, three miles from the Village of Lake Tomahawk and 22 miles north of Rhinelander. It occupies 17 acres in the heart of American Legion State Forest and has a beautiful main lodge, hobby shop, dining room, duplex recreation and lounge with fireplace, and 22 cabins for patients. 55 patients can conveniently be taken care of at one time in camp; ramps and toilet facilities are provided for the wheelchair cabins.

The camp is now financed by contributions from the Department of Wisconsin, American Legion membership annual dues. There is no charge to the patient or his family. The camp is governed by a five-member Camp Board operating under the Constitution and By-Laws of State Department of Wisconsin, American Legion. The camp superintendent is in immediate charge of the camp. A physician, nurse, and corrective therapist are in attendance during the regular camping season.

Honorably discharged Wisconsin veteran patients, who are convalescing and in need of rest and/or rehabilitation following injury or illness, may attend camp by application and upon approval of American Legion Post County or Service Officer, private physician and the camp physician. All recommendations by referring physician on patient's diet, rest, rehabilitation program, and precautions, are observed by nurse, corrective therapist and camp physician.

Disabled veterans going to camp should not be nursing-cases or require close medical supervision; should be able to take care of their own hygiene and personal needs such as toilet activities, bathing, getting in and out of bed, feeding, dressing themselves, and locomotion around camp either by wheelchair, or ambulation with rehabilitation aids. The patients should be well oriented mentally, able to understand camp rules and have the ability to get along with other campers. Veterans with active contagious diseases are not permitted.

Camp American Legion's setting is ideal for the rehabilitation of convalescing patients. It gives them the benefit of outdoor life, the birthright of all of us for the happy summer months. In the beautiful vacation atmosphere of northern Wisconsin, its resources are utilized to help the sick and disabled veterans of this State accomplish maximum adjustment. The motivating atmosphere of this vacationland is contagious to new campers and seems to give them the desire to live again.

At the opening of the 1955 season, an active corrective therapy rehabilitation program was introduced into this setting. From June 1st through September 15th, a certified corrective therapist, from Veterans Administration Hospital, Wood, Wisconsin, directs the program, on his vacation time, and without compensation.

This rehabilitation program was designed as a halfway house between hospital and adjustment to disease or disability within physical and mental limitations. The program is set up to expedite the patient's progress from the feeling of hospital dependency to independency, and thus bridge the gap between hospital, back home, and re-employment when possible. New methods and techniques are developed to enable the patient to participate. Activities are introduced that will help the patient mobilize his resources to regain his functional and adaptive recreational life. When rest and relaxation are the desired treatments, the outdoor life of pines and lakes, in the solitude of cool nights, provides this comfort. In some way, the camp program seems to influence the patient's psychological, physical and social life.

All personnel working at camp have the interest of the patients at heart and work together as a team. The camp superintendent, registered nurse, physician, and corrective therapist are on call and in attendance during regular camping season. Vocational rehabilitation counselors from the State, visit camp to see patients who are interested in re-employment. The American Legion Auxiliary workers assist the campers in many ways, as do the recreational leaders. The greatest responsibility rests with the camp superintendent, and the success of the camp depends upon its personnel.

Corrective Therapy Program

The physical restoration program is administered by a corrective therapist under the prescription of a physician, who specifies the desired treatment and

**Rehabilitation Program Director, Camp American Legion, Wisconsin.

Main Dining Hall
Hobby Shop
Shuffleboard Court

Cabin Interior
C. T. Clinic
Swimming Area

Archery Range
Boat Rides
Fishing Group

contra-indications to activity. The camp physician sees the patients regularly, and the corrective therapist treats them daily. One of the specific objectives of the corrective therapy program is to work *with* the patients, and not *on* them. Through cooperative relationships and an informal approach, corrective therapists teach and direct the camper while he accomplishes the objectives. Routine exercises are substituted for functional participation as soon as possible in adapted physical and recreational activities. For example, with a little instruction, swimming can again become a natural recreational activity for amputees, campers with neuromuscular disabilities, the blind, and others who enjoyed swimming before their illness.

Camp is well equipped, in the outdoor area, with therapeutic exercise equipment and rehabilitation aids to teach the patient ambulation and self-care activities. Apparatus such as resistive exercise tables, stationary bicycles, parallel bars, exercise mats, wall pulleys, shoulder wheels, stationary steps, and other therapeutic exercise equipment, is used under the direction of the corrective therapist. The problem here is not to convince the patients to participate in therapeutic exercise at camp, but to prevent them from overexertion. Equipment which was donated by various State Legion Posts is in constant use.

Some of the modalities used to improve the patient's disabilities are: 1) Conditioning exercises to develop strength, endurance, coordination, agility and thus prevent physical and psychological de-conditioning; 2) Functional ambulation and elevation techniques including the use of all types of devices to enable the camper to walk again; 3) Self-care activities so patient may take better care of his immediate needs; 4) Therapeutic and recreational swimming adapted for the individual patient's disability; 5) Special activities for orientation of the blind patients; 6) Test and measurements to check the functional ca-

pacities of the more severely disabled patients in activity of daily living tests, consisting of two parts, ambulation and self-care activities. The treatment program is very flexible to meet the patient's physical as well as psychological needs. If the campers enjoy the program, they are taking the shortest road to regain their health.

A complete record is kept on each patient prescribed for corrective therapy. Attendance and progress notes are submitted to camp physician regularly on patient's improvements, regressions, abilities, and reaction to camp program. Information can be forwarded to referring physicians, upon their request.

Last year, 240 patients attended camp. Among the major types of disabilities encountered were: Cardiacs, hemiplegia, blind, neuromuscular, post-operative, orthopedic, amputees of upper and lower extremities, and post-hospital neuropyschiatric — to mention only a few. The age groups ranged from World War I veterans through Korean veterans.

Attainments

In addition to developing new interests and deriving psychological benefits from camp, the patients have shown certain measurable improvements in strength, endurance, and functional capacity. For example, hemiplegics gain strength and improve coordination in affected lower extremities. This is demonstrated by improved functional ability in ambulating and playing games such as shuffleboard where balance is an inherent factor. Most patients ambulated at least between parallel bars, and several had not been on their feet to walk since their illnesses began. A leg amputee who had not been swimming in 15 years started to swim again with a few instructions, and swam daily during his stay at camp. This same patient had been a member of a domicilary for ten years, and unemployed. To date he is re-employed full time, at age 63, in a nursing home. A blind patient, with a below-elbow arm amputation, resumed his swimming program for the first time since his blindness. He had graduated from college last year, attending after becoming blind. He has written several letters in which he states how much the camp program has done for him in adjusting to his new recreational life. Cardiacs learned to adapt physical activities and re-establish their recreational lives in such activities as fishing, boating and hobbies of all types. Several lower extremity amputees have gone through complete training in the use of their prostheses. A complete movie is available on the various steps one amputee went through at camp before resuming work in his home town.

Recreation Program

Many leisure-time and adapted recreational programs are enjoyed by all. There are fishing trips, hikes through American Legion State Forest, motorboat trips, airplane rides, and water-skiing shows. A well equipped wood-working hobby shop is located in the main lodge. Driftwood hunters find many enjoyable hours in making the driftwood into lamps and displays. Cards, television, movies, and group singing are popular events in the main lodge when the campers get together. The feeling of competition is renewed through tournaments in shuffleboard, horseshoes, archery and other games; not only for the participants, but also for the spectators. Prizes are given weekly, for winners of tournaments, and for the camper who catches the largest fish. All campers are encouraged to attend the church of their choice on Sunday mornings, and transportation is provided.

Maintenance of the Camp

The camping situation demands certain re-socialization and physical effort on the part of the patients, which they are expected to carry out within the limits of their abilities. Many times necessity becomes the mother of invention to patients at camp. Details such as making beds, cleaning cabins, drying dishes, are carried out by the patients. Those who are building up work tolerances do various jobs around camp and in the shops. The patients assist each other and help the ones who may be in need of a little extra attention. This group-living experience in a permissive atmosphere has a natural re-socialization effect on the convalescent patient.

With the problems of an aging population facing our Nation, and the average life expectancy steadily increasing, we hope that rehabilitation in camping is making disabled Wisconsin veterans' lives more useful and enjoyable. Medicine has added years to the lives of our disabled; now it is the opportunity of Camp American Legion Rehabilitation Program to add *life* to those years. By rendering this service to the veteran and his family, the Nation as a whole will benefit.

I have discussed the beautiful setting of Camp American Legion into which an active rehabilitation program has been introduced. By utilizing one of the keys to good rehabilitation, namely motivation, some of the effects of the program have been cited. Complete rehabilitation has been demonstrated in the older age groups by adjustment to disability, and in some cases by re-employment after many years of idleness. With increased finances Camp American Legion could easily be developed into a hospital-to-job rehabilitation program for patients desiring re-employment.

A HEELCORD STRETCHING DEVICE

DAVID S. BILOWIT, C.C.T. *

The customary method of stretching the heelcords (gastrocnemius and soleus) is to place the patient in a supine position and manually apply pressure by forcing the foot into dorsiflexion. In addition to requiring the services of a therapist and the use of a plinth, this method also introduces the problem of contraction of the antagonist muscle group when the patient does not have control over the amount of stretch. The device described below allows the patient who is able to stand to self-stretch the heelcords without assistance, thus replacing manual stretching by the therapist.

For patients who are able to stand with support from the stall bars, the stretching device (Fig. 1) is placed on angle, one end over the lower stall bar, the height of the bar determining the degree of heelcord stretch. The patient stands on the board, facing the stall bars with his heels placed firmly against the lower end of the board. Wheelchair patients may wheel their chairs to the end of the board and pull themselves erect with the aid of the stall bars. Then by extending the hips (drawing hips forward) the feet are forced into a dorsiflexed position, and the heelcords are stretched.

The following advantages are noted in the use of this device:

1. The patient is always in a position to control the degree of stretch so that involuntary contraction of antagonistic muscles does not occur. The patient is relaxed because he is able to terminate the stretch immediately if he experiences pain.

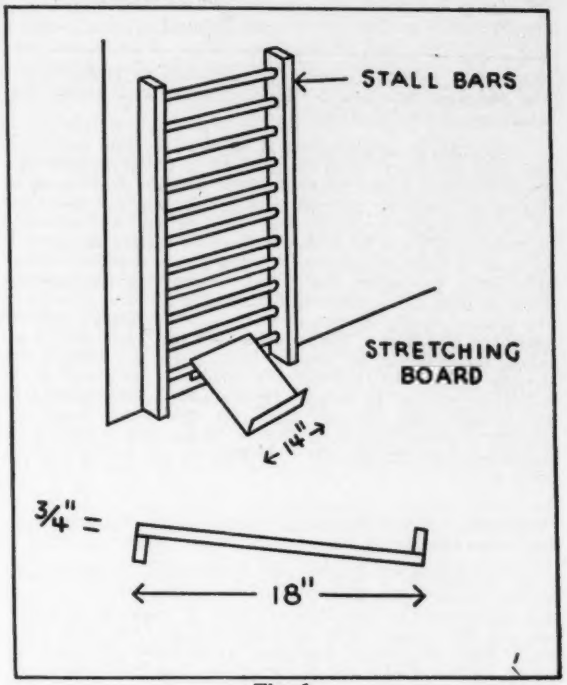

Fig. 1

2. The patient's body weight is used as the power source rather than the force of the therapist's hands and arms. Thus greater power, less resistance on the part of the patient, and no physical effort by the therapist results in a more efficient stretching method.
3. The device saves time by omitting the five minutes minimum required to manually stretch one patient's heelcords. An average of four-five patients use the device daily after being shown only once how to use it.
4. Plinth space is saved for exercise by another patient who may be working while two boards are being employed simultaneously side by side in an area smaller than that required by the plinth.

Fight Mental Illness

MH

National Association for Mental Health

LONG TERM PATIENT—Cont'd from P. 133

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"From Other Journals"

William B. Bean, "A Critique of Criticism in Medicine and the Biological Sciences in 1958." *Perspectives in Biology and Medicine*, I:224-232, Winter 1958.

Criticism in medicine and in science has been neglected. To cultivate the critical faculty one must have facts and know how to identify data. The true and the false must be separated. Data do not comprise science but are the stuff from which science arises. There can be no valid generalizations until facts have accumulated in sufficient quantity to make a solid foundation. Contemporary medical education tends to deaden the critical faculty by emphasizing facts instead of relations and functions. Failure to develop the critical faculty is shown by the naive acceptance by the physician of a host of highly advertised but unproved medicines. Criticism is by nature destructive, but unless we destroy the second-rate and the erroneous they will cause biological science to wither. In medicine error endangers the patient. The scientist may feel threatened when his work is attacked, but in a mature person this tendency to resent criticism subsides. If he is wise, he may profit greatly from it.

"Discussion: Hydrotherapy. Is It of Value?" *Proceedings of the Royal Society of Medicine*, 51:94-100, February, 1958.

Dr. R. Harris: A surprisingly large amount of physiological research has been done on hydrotherapy, but accurate assessments of the *clinical* value of these proceedings has not been made. Hydrotherapeutic measures have generally been used with conditions of obscure pathology in which the enthusiasm of the physician and the impressive ritual of hydrotherapy are valuable additions to the therapeutic effects of water. The two principal aspects of its current use are as an exercise medium and for thermal or mechanical stimulation. It is indispensable for conditions in which the muscles are too weak to overcome the force of gravity, but will other patients gain maximal muscle power and function more quickly from it than from "dry" exercise? Will the end result be the same? We have only overall clinical impressions; not critical assessments. Controlled clinical trials are urgently required.

Dr. J. H. Jacobs: Benefits from hydrotherapy result only from the patient's active co-operation in using such muscle power as he has. One of its benefits, early ambulation, is difficult to duplicate by any other means. It should be considered a form of exercise therapy which is particularly suited to the treatment of weakened muscles, but progression to more vigorous forms of exercise should take place at the earliest opportunity.

Dr. T. G. Reah: Co-ordinated movements to produce a natural movement, such as rising from a chair, are more satisfactorily taught on water than on land. Two therapists working in a pool are much more satisfactory than is one working alone.

Philip Solomon, "Sensory Deprivation and the Human Mind." *Research Reviews*, April, 1958, pp. 9-11.

Subjects placed in experimental situations which block the usual sensory input often develop mental abnormalities. The introverts break down before the extroverts. The experiments suggest that patients who may already be near the mental breaking point may develop psychotic-like states when confined in a respirator, forbidden visitors, eyes bandaged, or otherwise deprived of the usual sensory cues. Darkness, silence and solitude should be avoided in their surroundings. Drivers making long trips, particularly on superhighways, assembly line workers, and isolated individuals may also be jeopardized by the lack of sensory stimulation.

John L. Morgan, B. D. Tidwell and Edward J. Ryan," Urinary Findings in College Athletes Following Contact and Noncontact Sports." *Journal of Laboratory and Clinical Medicine*, 56:935, December, 1957.

Urinary findings were recorded on college football players, cross country runners and basketball players. Albuminuria and cylindruria were common following athletic contests and usually subsided in a short time after resumption of average daily activities. Body contact is not necessary for their production.

F. A. Hellebrandt and S. J. Houtz, "Methods of Muscle Training: The Influence of Pacing." *The Physical Therapy Review*, 38:319-322, May 1958.

Rate of working is the critical variable in training programs designed to increase muscle performance. The amount of work done per unit of time may be augmented by increasing load or speed. The functional capacity of a muscle increases when the speed is kept constant and the resistance is systematically increased. There is an optimum speed for exercise of every degree of severity. In this investigation the loads, repetitions and rest pauses were held constant, while the speed of the exercise was progressively increased to a pace faster than the optimum. Six normal adult females trained on the radio-ulnar ergograph. Only supination was studied. Increases in speed were found to be as effective as increases of load in augmenting functional capacity.

Editorial, "Modern Humours." *British Medical Journal*, 5076:939, April 19, 1958.

In the Hippocratic view and the James-Lange theory the production of a humour by an organ created a corresponding emotional state. The discovery that the adrenal medulla under the influence of the sympathetic nervous system and the adrenal cortex under the influence of the hypothalamic-pituitary system can liberate substances having metabolic and vascular effects on the skin, muscles, and viscera, and simultaneously modifying the function of the CNS, offers a testable hypothesis. Blood levels and adrenal secretion rates can be found in the anxious, the angry, the athletic, and the idle. It is claimed that the anxious excrete a good deal of adrenaline and not so much noradrenaline, whereas active aggressive feeling shows a high output of noradrenaline. In heavy muscular activity the output of both is high. It is said that people with a high resting excretion of noradrenaline are the least likely to black out during acrobatics. The aim of the modern study of humours is to replace the term "stress" by a description of a series of precise physiological, physical or chemical events, each of which has its particular sequence of humoural responses and consequent metabolic effects. In this way the stress theory of disease may be given meaning.

Robert E. Olson, "Food Faddism—Why?" *Nutrition Reviews*, 16:97-99, April, 1958.

Food faddism is economically wasteful and scientifically unsound, but it persists and grows in spite of scientific advances in knowledge about nutrition. Food has an emotional value, and food faddists capitalize upon this. Individual food faddism generally stems from acute or chronic psychological aberration; probably group faddists are psychologically exploited rather than psychiatrically ill. Typical fallacies are those which attribute exceptional nutritional values to a single food (yogurt, black strap molasses, wheat germ oil, etc.); rejects fruits and vegetables grown with commerical rather than "organic fertilizers" (biochemical analysis reveals no significant differences); advocates daily use of vitamins, trace minerals or other nutrients (there is no evidence that supraoptimal levels of these nutrients improve health, but they may harm it); urges certain foods or systems of dieting (steak and prunes, raw tomatoes and hard boiled eggs) to cure disease. Food faddism can be combatted by programs of nutrition education and by improved standards of clinical nutrition.

John L. Reichert, "Competitive Athletics for Pre-Teen-Age Children." *Journal of the American Medical Association*, 166:1701-1707, April 5, 1958.

Vehement arguments center on the question of athletic competition for children under 13. Competition is a part of life, but competitive drives must not be overstimulated. Pre-adolescents are vulnerable to physical injury and to physiological damage. The emotional pressures engendered may affect emotional development and social adjustment. There is evidence that those engaged in competitive athletics are less healthy than those who are not. Children should have an opportunity to develop skills in a wide variety of activities, including competitive and non-competitive athletics. Opponents should be carefully matched. Body contact sports are dangerous at this age. Professional leadership and medical supervision is essential. Regular leagues, tournaments, and any form of commercial exploitation should be forbidden.

Herbert T. Hudgens, "Health of the American Indians." *Journal-Lancet*, 78:108-110, March, 1958.

In 1955 the Public Health Service took over administration of the medical program for Indians. The health needs of the 315,000 Indians on 250 reservations in 24 states are critical. Average age at time of death is 39, compared with 60 for the general population. 33% of these deaths occur before the fifth year of life, compared with 8% in the general population. Among the Northern Plains Indians deaths from influenza and pneumonia are nearly four times that of the general population; the death rate for TB is five times; that for enteric diseases is ten times.

Unless noted otherwise, all abstracts have been prepared by Philip J. Rasch, Ph.D.

Book Reviews

"Preventive Geriatrics." Reprinted from The Journal of the Michigan State Medical Society, 56:589-610, May, 1957. Paper. Free.

This is a report of a panel discussion on the role of nutrition, physical development, education, and exercise in Preventive Geriatrics conducted by the Geriatrics Committee of the Michigan State Medical Society. The paper is composed of excerpts from statements made by the panel members. The names of many of the latter will be familiar to corrective therapists—Rusk, Morehouse, Montoye, Michael, McCloy, Walters, Wessel, Jokl, etc. A copy of the article has been sent to each member of the American College of Sports Medicine, and it is announced that additional material concerning the care of geriatric patients will be published later on.

PJR

"Scouting with Handicapped Boys." (New Brunswick: Boy Scouts of America. 1957. 64 pp. Paper. 75c.) (Available through local Boy Scout offices and Boy Scout distributors.)

The objectives of Scouting are to help boys attain character development, citizenship training, and physical fitness. The latter is a matter of individual capacity. The need is to help the handicapped boy improve what he has. Having established these points, this booklet goes on to discuss the channels through which the handicapped may be incorporated into Scouting and the extent and kinds of handicaps, "success stories" of individuals and troops who have successfully overcome crippling handicaps, sources of help, and bibliographic materials. This is effective propaganda for a praiseworthy movement.

PJR

"Sport and Society," edited by Alex Natan. (London: Bowes & Bowes, 1958. 208 pp. $2.94)

This symposium is avowedly an attempt to discuss modern competitive sports in terms of sociology and psychology. Surprisingly, its contributors have largely been drawn from the ranks of the actors, journalists, novelists, painters, and the like, although a majority of them are—or were—athletes of considerable distinction. However, the sociologists and psychologists are conspicuous by their absence. This leads to some odd omissions. The journalist discussing sport in France fails to observe that the Frenchman's disdain for the work and self-discipline required to become a great champion may be directly related to the fact he also disdains the effort and self-discipline required to be a great nation; or that his feeling for dishonesty in sports may be related to his notorious dishonesty in the matter of paying his taxes. It is fascinating to read that in France the masses have taken sport away from the upper classes, while in Italy an interest in sport is spreading from the masses to the upper classes. One longs for a competent sociologist to interpret the meanings of these diametrically opposed trends.

One of the contributors is a student of psycho-analysis, and displays how the Freudians manage to pervert everything to fit their mythology: squash players and billiard players are engaged in a symbolic pursuit of the nipple; lacrosse is an attempt to steer the penis into the vagina; the batsman who ignores the bad pitches and swings at the good ones makes a judicious selection between the good and the bad breast; when he is put out he is symbolically castrated, etc. *ad nauseum*.

Of the 18 chapters, 6 are written by Britons, 6 by Germans, and 6 by Continental Europeans. Rather peculiarly, neither the United States nor Russia are represented. The chapter supposedly dealing with the United States turns out to be reminiscences of sports writing by a German now living in Switzerland! If any one thread runs through the book, it is that sports (particularly the Olympic Games) have so clearly become instruments of national propaganda that they appear in danger of disappearing entirely from the life of the average citizen. The repeatedly expressed opinion that the Olympic Games no longer have a justification bodes ill for their future.

In spite of the fact that the book does not live up to its promise, it is important as an expression of the views of athletes, sports writers, physical educators, and others closely associated with European sport. The definitive works on the sociology and psychology of sport are yet to be written. When they are this book, like Cozens and Stumpf's *Sports in American Life* (reviewed here July-August 1954) and Jokl et al.'s *Sports in the Cultural Pattern of the World* (reviewed here March-April 1957) will be important references.

PJR

"Clinical Heart Disease," by Samuel A. Levine. (Philadelphia: W. B. Saunders Co., 1958. 636 pp. $9.50)

This new fifth edition of Levine's *Clinical Heart Disease* is a fine contribution to the field of clinical medicine. Many texts on cardiology have appeared over the years, but none have surpassed Levine's clinical descriptions. This edition presents, as in previous editions, an approach to understanding diseases of the heart based on the personal observations and experiences of bedside diagnosis and care of the cardiac patient, as well as many years experience as teacher in this field. Soundly based on correlation of clinical features with the disturbed underlying physiology, the present edition places surgery of the heart in proper perspective. The author states, " . . . it is no longer sufficient to simply diagnose mitral or aortic disease . . . we are now challenged to estimate the degree," and to instigate procedures heretofore unavailable for the stricken patient.

The former chapter on congenital heart disease has been completely revised, and additions to the chapters on electrocardiography and vectorcardiography have been included. Anyone interested in cardiology or care of the patient with heart disease will find this classic of inestimable practical use.

MLB

"Functional Bracing of the Upper Extremities," by Miles H. Anderson. Edited by Raymond E. Sollars. (Springfield: Charles C. Thomas, 1958. 463 pp. $9.50)

This tome —the first of its kind— is designed to show the various types of braces and assistive apparati which may be utilized to aid the individual who has suffered some degree of upper extremity paralysis. It was originally prepared as course material for classes for paramedical personnel, and has been brought together here for the benefit of other workers in this field. The text discusses functional anatomy of the hand, functional assistive hand splints, feeders, special assistive devices, basic anatomy of the arm and shoulder, biomechanics of functional hand splints and arm braces, and functional arm braces. The discussion is very detailed: the technique of making a splint, the mechanical principles of ball-bearing feeders, the process of fitting a functional upper extremity unit, and similar matters are presented in step-by-step fashion. Most of this material falls within the area of the orthopedist and the prosthetist rather than the therapist. While it is especially recommended to the two former, it will be valuable in showing the therapist the type of functional braces which are available and in giving him an understanding of their capabilities and limitations.

This work has had the fiscal support of the Veterans Administration and has been coordinated by the National Academy of Sciences. The author predicts that better methods and devices will be developed with time. This is no doubt true, but the present volume will have played an important role in that development by bringing together in one convenient book the best available at the present time. The text is clearly written and is profusely illustrated. It should be in the library of every hospital and rehabilitation center concerned with the problems of upper extremity bracing.

PJR

"Fat Consumption and Coronary Diseases: The Evolutionary Answer to This Problem," by T. L. Cleave. (New York: Philosophical Library, Inc., 1958. 38 pp. $2.50)

All too frequently basic biological principles are not utilized to evaluate a problem of health or to predict its future course. In this small monograph the author has attempted to apply Darwinian principles to taste, or, more comprehensively, the instinct of appetite and its role in the present menace of coronary disease. He accepts the thesis that coronary disease is the result of fat overconsumption. The instinct of appetite would prevent this if allowed to select "natural" substances according to one's needs, if it were not for two factors: (a) "some alteration from the natural state in the fats," and (b) "some unnatural interference with the exercise of the instinct." The author rules out the former possibility on evolutionary principles, on the basis that if allowed to choose, the instinct of appetite can be relied upon to select according to the individual needs. Regarding the latter, however, this instinct is prevented from "natural" operation largely by "arbitrary meals" and "arbitrary food mixtures." The first prevents selection according to biological need, and the second by "unnatural" mixing of fats, carbohydrates, etc. Prevention of coronary disease lies in application of these principles to dietary intake. Any one interested in this problem will find at least an interesting and refreshing approach to a problem with many suggested solutions.

MLB

"Casting and Angling," by Julian W. Smith and Committee. (Washington, D.C.: American Association for Health, Physical Education, and Recreation, 1958. 48 pp. Paper. $2.00)

This booklet is one of the Outdoor Education series and is designed as a guide for those charged with teaching angling in the physical education program. It covers equipment and techniques, hints for instructors, games, clubs, equipment, fishing tackle, and reference material. This sport appears to have much to offer paraplegics and certain other handicapped individuals.

PJR

"Team Sports for Girls," edited by Ann Paterson. (New York: The Ronald Press Co., 1958. 396 pp. $5.00)

Paterson presents her book *Team Sports For Girls* with the assumption that the physical educator fully understands the games. She has given a short review on the value of team sports and on their teaching, discussing both the responsibility of the individual and what is expected of the teacher. The text is complete in that it covers all team sports that girls customarily play and each is handled in an excellent manner: brief history, the game, facilities and equipment, fundamental skills, lead up games, drills, good coaching, playing hints, suggested teaching progression, brief summary of rules, including glossary, and safety factors. In each case there has been ample use of plates and illustrated sketches. This book is recommended as a source book for physical educators in the women's field.

MR

"From Program to Facilities in Physical Education," by Harry A. Scott and Richard B. Westkaemper. (New York: Harper and Brothers, 1958. 483 pp. $6.50)

"The primary purpose of this book is to enable the development of better programs of Physical Education both now and in the future by improving the physical facilities for the program in schools and colleges."

The text was written for students, architects, teachers, and all administrators interested in facilities for a physical education program. Emphasis is placed on long-range planning for the acquisition of functional facilities to meet the needs for the present as well as a future program in the physical education department. General remarks are devoted to programming in the discussion on the use and value of the facilities. Detailed descriptions and graphic illustrations are provided for the construction of the following areas: indoor facilities for elementary, junior and senior high schools, and colleges; swimming pools for all purposes; the field house; outdoor facilities for schools and colleges; and the stadium.

The book is an invaluable source of reference for administrators or personnel interested in developing the many areas of physical education.

HJB

"Fundamentals of Human Physiology for Students in the Medical Sciences," by W. B. Youmans. (Chicago: The Year Book Publishers, Inc., 1957. 567 pp.)

The purpose of this book is to present the fundamentals of physiology for students of the medical sciences and to keep the presentation brief by the elimination of material which is usually covered in courses in anatomy and biochemistry. Considerably more attention is given to the physiological effects of drugs and diseases and to neurophysiology than is true of the average text. The maintenance of brevity, of course, results in certain losses. The reviewer had occasion to do a considerable amount of reading re the musculoskeletal system and fatigue while this text was on his desk and found the latter considerably less useful in these respects than some of the other books. Rather oddly, the review copy includes two entirely different types of paper. Illustrations—mostly drawings—are plentiful and the index appears quite complete. The book appears to have a definite use, but the corrective therapist should be sure that it covers in satisfactory detail the areas in which he is most interested before purchasing a copy.

PJR

"Artificial Limbs," Autumn 1957.

This entire issue is devoted to the hip-disarticulation prosthesis developed in Canada. After an introductory discussion of the medical significance of hip disarticulation, the balance of the journal is devoted to a series of papers on the Canadian-type prosthesis—its evolution, biomechanics, construction and fitting, and the experiences of its users. The consensus of opinion is that the apparatus is highly satisfactory. For those working in this field the data should be both interesting and important.

PJR

"The Appraisal of Applicants to Medical Schools," edited by H. H. Gee and J. T. Cowles. (Evanston: Association of American Medical Colleges, 1957. 228 pp.)

The 1956 Association of Medical Colleges' Institute on Evaluation of the Student focused upon the appraisal of applicants to medical schools. Evidence presented in this detailed report includes (1) The Broad Perspective; (2) Intellectual Characteristics of Applicants; (3) Non-Intellectual Characteristics of Applicants; (4) Overall Appraisal of the Admission Process. Appendices cover supplementary tables, bibliography, summary of on-going and recent research, and a roster of participants.

Educators have evaluated applicants from the data obtained by interview and psychological testing (intellectual and projective.) The editors present the data in written and tabular form from material gathered by leading medical schools and correlate it where possible. All aspects of the evaluation of medical applicants by admission committee, which included the anthropological, sociological and psychoanalytical concepts, were considered.

Presented in the form of a panel discussion, data gathered from the admission committee reports of many of the leading medical schools is compared, and a summary of the conclusions from such "findings" completes the report.

To admission committees, educators and administrators of teaching institutions, this report should serve as a stimulus for further study of a continuing problem—appraisal of applicants. Results to date indicate the need for a more thorough re-evaluation of methods and the development of techniques where allied disciplines such as psychiatry, psychology, and sociology may be integrated so that an over-all approach may be developed. This report indicates that the interview and I. Q. are not sufficient for an adequate appraisal of applicants entering medical school if the over-all objective of such training is a mature personality trained in the medical services.

Such reports as the above on method and techniques as used in recognized teaching institutions should be made required reading for all admission and credential committees. It will be of definite value to the sincere educator whether his teaching be in the pre-medical or medical sciences.

DCL

"Hypnography," by Ainslie Meares. (Springfield: Charles C. Thomas, 1957. 271 pp. $7.75)

Ainslie Meares, an analytically oriented psychiatrist of Melbourne, Australia, has again written a text on his favorite subject, the unconscious. In this book he gives us techniques, results, and conclusions as related to the graphic-art production of unconscious material by the patient while under hypnosis. It is clearly written and adequately explained, with case histories and patients' drawings. The use of hypnography as a method of investigating repressed conflicts may provide an additional technique to be used in the "uncovering" psychotherapies. To the psychiatrist, research worker, and the allied discipline in the mental health field this book will be of interest as a specific presentation of a specialized investigative technique. The index is adequate.

DCL

"The Neuroses and Their Treatment," Edited by Edward Podolsky. (New York: Philosophical Library, n. d. 555 pp. $10.00)

Over forty papers on the treatment of the neuroses have been collected by Editor Podolsky. Reprinted from previous contributions to journals in the vast field of psychiatry, the contents range from child psychiatry to the Grantham Lobotomy, from psychoanalysis to carbon dioxide therapy, and from organ neuroses to Miltown. As a library "filler" this volume may serve a purpose, but the papers included are not representative of the better articles published in the outstanding journals from which the editor has made his selection. To those interested in the behavioral sciences who have the leisure for such reading the book may prove of interest. There is no index and no bibliography.

DCL

"Swimming-Instructor's Guide" and "Lifesaving-Instructor's Guide," by David H. Robertson and Charles W. Russell. (Chicago: The Athletic Institute, 1958. $2.00 each. 44 pp. and 35 pp. respectively. Paper.)

These booklets are reproductions of sound-accompanied slide films taken from the *Beginning Sports Slidefilm Series* published by the Athletic Institute. Both begin with information regarding techniques for projecting the actual slidefilms and are followed with teaching standards, facilities, safety precautions, and suggestions for the instructor. In *Swimming*, the main body of material consists of four units: Learning to Enjoy the Water, Learning to Swim, The Elementary Backstroke, and The Side Stroke. Each unit consists of the printed pictures of the actual slidefilms with the recorded narrations accompanying each frame. The second unit is devoted to the dog paddle and the crawl stroke. The other three units are self-explanatory. The booklet concludes with selected references and available motion pictures. *Lifesaving* is written in the same style, but devoted to the program and methods for teaching Junior and Senior Lifesaving Courses. The two basic units consist of "Rescue Methods" and "Resuscitation."

Although the booklets are interesting, it is felt that a review cannot do justice to the material without considering the slidefilms themselves.

HJB

"Defend Yourself!" by Jack Grover. (New York: The Ronald Press Company, 1958. 80 pp. $2.95)

This addition to the Barnes Sports Library is a curiously formless volume. Mixed in with eminently practical advice on self-defense is material on common knots, first aid, descriptions of some forms of *katsu* not mentioned in Karpovich's volume on artificial respiration (together with the comment that they should not be used except by experts), calisthenic exercises, and other seemingly extraneous matter. There are some surprising omissions, and some of the material needs to be expressed with certain reservations. The author states he has studied *amachakuy*, a system certainly unknown in this country. Unfortunately, the only maneuver he describes from its repertoire proves to be one commonly used by street brawlers here.

There are so many books now on eclectic methods of self-defense that it is difficult to see the need for another. What is needed is for someone to study the various systems such as jiu jitsu, karate, amachakuy, r'bah, and gung fu, and give us a comparative analysis of their philosophy, techniques, virtues and weaknesses. Such a study might very well show that the differences between them are slight indeed.

PJR

BOOKS RECEIVED

"Selected Fitness References." Fitness Series No. 1. (Washington, D.C.: A.A.H.P.E.R., 1958. 16 pp. Paper. 50c.)

Bibliography of materials on fitness, classified under General Reference, Health Education, Physical Education, Recreation and Outdoor Education, Sports and Athletics, Professional Education, and Public Relations.

"The Ford Foundation Annual Report."

October 1, 1956 to September 30, 1957 report of a foundation whose "General purpose is to advance human welfare."

"The Preservation of Youth," by Moses Maimonides. Translated by Hirsch L Gordon. (New York: Philosophical Library, 1958. 92 pp. $2.75)

Health views of a noted 12th Century Hebrew physician.

"Fall 1957 Statistics on Enrollment, Teachers, and Schoolhousing in Full-Time Public Elementary and Secondary Day Schools," by Samuel Schloss and Carol Joy Hobson. (Washington, D.C.: U.S. Government Printing Office, 1958. 13 pp. $ .15. Paper.)

Fourth annual survey report.

"Health and Physical Education Microcards." 15 March 1958 Supplement to 1 October 1957 Bulletin. Eugene: University of Oregon. Free.

News and Comments

GLAUCOMA A THREAT TO MEN OVER FIFTY

About one in each 19 men over the age of 50 is faced with possible blindness from the eye disease, glaucoma, a survey announced by Veterans Administration indicates. VA said the finding emphasizes the importance of frequent and thorough eye examinations for persons in this age group so that the disease can be detected in time for early treatment. The survey was made at the VA outpatient clinic in Brooklyn, N. Y.

Use of improved techniques for examination of all veterans over 50 coming to the clinic during the past three years has revealed signs and symptoms of developing glaucoma in 140 of 2,600 patients. Dr. Jacques Landesberg, the clinic's chief of ophthalmology, said glaucoma is a disease in which pressure builds up within the eye, causing progressive blindness and ultimate destruction of the optic nerve.

Since deterioration from chronic glaucoma is gradual and with no particular early discomfort, victims usually are not aware of this disease in its earlier stages, he said.

In addition to usual eye examination, Dr. Landesberg's program for detection of glaucoma included routine measurement of pressure within the eye, by use of an instrument called a tonometer, and taking of color photographs with a camera especially designed to photograph the back of the eye. Dr. Landesberg said the photographs are useful to show cupping of the optic nerve head.

NEW DRUGS SAFE FOR GERIATRIC PATIENTS

A new drug for treating arthritis, rheumatism, and allergies is especially suitable for old people and others with heart conditions, Veterans Administration reported recently. Va said research at the VA center in Martinsburg, W. Va., has produced definite evidence that triamcinolone, a newly developed drug of the cortisone family, can be used safely for heart patients.

Dr. Thomas H. McGavack, chief of intermediate service at the Martinsburg center, said triamcinolone can be administered even to oldsters with severe heart failure without doing harm. Most of the anti-inflammatory drugs related to cortisone make the condition of heart failure patients worse by increasing retention of salt and water, Dr. McGavack said.

The finding on triamcinolone is one of the results of a multi-pronged program of research into problems of aging conducted by Dr. McGavack at the Martinsburg center during the past year.

VA BLOOD TEST DEVELOPED FOR RARE DISEASE

A new blood test may help doctors diagnose a comparatively rare but frequenty fatal disease in time for effective treatment, Veterans Administration has reported. The disease, called LE (for lupus erythematosus), affects the connective tissues of the body and may attack the skin, joints, kidneys, and other organs, Dr. Ruth H. Wichelhausen of the Washington, D.C., VA hospital said.

The test uses a blue dye, called 2-6 dichlorophenol-endophenol, that changes color when mixed with a blood sample from a person who has LE. It often shows the presence of the disease even before definite clinical signs and other laboratory signs can be detected.

The method was devised by Dr. C. David Cooper of George Washington University and Drs. Thomas McPherson Brown, William R. Felts, and Ruth H. Wichelhausen of that university and the D.C. VA hospital.

Dr. Wichelhausen explained that distinguishing between LE and rheumatoid arthritis at an early stage has been extremely difficult in some cases because symptoms are so much alike. Early definite diagnosis in these patients is most important, since LE must be treated differently from arthritis.

TB COSTS DOWN

The cost of caring for tuberculosis patients in Veterans Administration hospitals dropped by $38 million during the past three fiscal years, VA has reported. Dr. W. B. Tucker, VA director of tuberculosis service in Washington, D.C., said the reduction can be attributed in large part to improvement in treatment for the disease, much of which resulted from findings of VA research. Newer drugs and other treatment for tuberculosis have shortened periods of hospital stay for TB patients, he said. If the average daily TB patient load in VA hospitals had remained at the 1954 level, approximately $38 million more would have been needed for hopsital care of VA TB patients than actually was spent over the past three fiscal years according to Dr. Tucker.

For the past 12 years, VA has conducted a joint research project with the Armed Forces which is the world's most extensive study of drugs against TB. Involving some 37,000 tuberculosis patients, the study has produced findings leading to present use of TB therapies by the entire medical profession.

Dr. Tucker said success of this study has shortened the duration of hospital stay for TB patients, reduced the liklihood of disability from the disease, and speeded the decrease in number of beds required for veterans with TB in VA hospitals. He said that the average duration of hospitalization necessary for successful treatment of TB formerly was about two years, while TB hospitalization today usually is necessary for less than one year.

TB patients today usually are able to return to productive employment soon after hospital discharge while in the past the patient discharged after TB treatment had to undergo prolonged rest at home and gradually build up his strength.

Prior to development of the newer drug therapies, the relapse rate in TB ran from 35 to 50 percent according to Dr. Tucker. He said that today, relapse rate has been narrowed down to less than 5 percent and during the past 10 years the hospital death rate in TB has been cut from more than 5 percent to about 1 percent.

WORLD MENTAL HEALTH YEAR IN 1960

Plans for a World Mental Health Year in 1960 sponsored by 108 mental health and professional societies in 43 countries and territories has been announced at the New York office of the World Federation for Mental Health. Following the pattern of the International Geophysical Year, the purpose of the program is to stimulate mental health activities, including research, with a maximum of international co-operation.

The Federation, a non-governmental organization which includes 29 societies in the United States and 79 in 42 other countries, reports a world-wide increase in work for the promotion of mental health during the ten years since it was organized, not only in countries where it has member societies, but in a number of others with which it has no formal link.

AMA APPOINTS DR. NUNEMAKER

Dr. John C. Nunemaker, Director of the Education Service in the Veterans Administration Department of Medicine and Surgery in Washington, D.C., has been appointed Associate Secretary of the American Medical Association Council on Medical Education and Hospitals in Chicago. Dr. Nunemaker came to VA Central Office in Washington in March 1952 and headed the VA Research Service from that date until July 1952, when he was appointed to his present position.

As Director of the Education Service, he has been responsible for VA's education and training programs involving affiliation with 72 medical and 21 dental schools; graduate training for 2,500 residents in 21 hospitals specialties; and postgraduate and in-service training for 4,500 fulltime physicians, 800 dentists, 15,000 nurses, and some 10,000 fulltime and trainee personnel in the auxiliary medical field

Physical Education Students from the Boston University School of Education who Received Clinical Training in Corrective Therapy at V.A. Hospitals, West Roxbury and Brockton, Mass., Feb.-May, 1958. Front Row—Anthony Donatelli and Eugene Ellis. Rear Row—Robert Daoust, Edward Silva, Robert Driscoll and David Settele.

The program is under the direction of Dr. Arthur Miller, Professor of Education at Boston University, and the chief corrective therapists at the two hospitals.

PINE TREE LINKED TO RARE LUNG DISEASE

A mysterious and sometimes fatal disease, sarcoidosis, was linked to the Eastern pine tree by Veterans Administration research announced recently. VA said studies indicate pollen from the East Coast pine may be a cause of the tuberculosis-like disease.

Dr. Martin M. Cummings, director of the VA research service in Washington, D. C., said two chemicals found in wax from the pollen also are found in the tuberculosis microbe, and are similar if not identical to materials found in sarcoidosis lesions by British investigators.

Additional evidence of a link between the tree and sarcoidosis is a chart prepared by VA which shows the birthplace of 1,200 veterans with the disease. Distribution of the disease in the United States correlates closely with a map of pine tree areas on the East Coast, Dr. Cummings said.

Dr. Cummings and Dr. Paul C. Hudgins of the VA hospital in Washington, D. C., found few cases of sarcoidosis among veterans born in the Western United States.

After noting that pine pollen stains with special dyes in the same way as do microbes that cause TB, the two researchers analyzed pollen from the East Coast pine. They discovered it contains a wax made up of Compound A and diaminopimelic acid, both of which are constituents of TB germs.

Another chemical portion of pine pollen, a phosphatide, produces small nodules in guinea pigs similar to lesions of sarcoidosis, Dr. Cummings said.

If these compounds are found in sarcoidosis lesions, the evidence suggests the disease may result from hypersensitivity of some persons to pollen of the Eastern pine, he said.

Although the incidence of sarcoidosis in this country is not known, Dr. Cummings said VA studies suggest there are about five cases among each 100,000 hospitalized white veterans and about 50 among each 100,000 hospitalized non-white veterans.

THE HAZEL WILBRAHAM RESEARCH GRANT OF THE WOMEN'S NATIONAL AQUATIC FORUM

In order to stimulate and promote needed aquatic research, the Women's National Aquatic Forum has established an Annual Research Grant, of an amount up to $300.00, to be awarded to one or more qualified women in the profession, either graduate students or workers in the profession.

Applicants for the Annual Grant shall submit by November 15th to the Chairman of the Women's National Aquatic Forum, five copies of the following:

1. A detailed outline of the proposed project including
   a. The complete statement of the problem.
   b. The probable value of the study and its contribution to the profession.
   c. The proposed procedure, including method or design, the subjects or other sources of data, techniques to be used in gathering and analyzing the data, and the present status of the study.
   d. Date of initiation and probable duration of the project.
   e. Estimated expenses involved in conducting the project (itemized).
2. Information about the applicant, including
   a. Education and degrees earned, names of institutions, and dates.
   b. Professional experience — institutions, positions held, dates.
   c. Present position or occupation.
   d. Complete description of applicant's responsibility for the proposed research project—for a degree, independent research, part of a larger project, and any other financial support received or expected.

Each outline submitted in competition for the grant will be judged by the research committee on its merit as a research project and a contribution to the profession. Grants will be announced and awarded at each December business meeting of the Forum. Recipients will be expected to present a report of the completed project at a subsequent meeting of the Forum, in person or by proxy.

Send five copies of the information outlined above to the chairman, women's national aquatic forum,

Anne K. Ross
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BLIND EMPLOYEES TRANSFERRED SUCCESSFULLY TO NEW JOBS

Who says handicapped workers don't have flexibility on the job? Five blind dictating machine transcribers at the Veterans Administration Veterans Benefits Office in Washington, D. C., have shown that they do. The five formerly made up a transcribing "pool" in the VA insurance Center in Washington, Several weeks ago the center moved to Philadelphia, and the "pool" had to be disbanded.

The blind employees, for whom insurance terminology had become second nature, had to be transferred to other jobs. Three—Mr. Jean Dorf, Mrs. Helen F. Litvin and Mrs. Dorothy J. Richardson—moved over to the Claims Service of the Veterans Benefits Office. Here they joined two other blind dictating machine transcribers, Vernon A. Butler and Leon R. Trainer.

The remaining two—Catherine M. Kolton and I. Lenore Swope—were assigned to the Medical Division of the Veterans Benefits Office, which already was employing another blind transcriber, Mrs. Dorothy Corso who, in 1956, had won an outstanding performance award.

In a matter of days, VA reported, the five blind employees had adjusted to their new working conditions and new vocabularies shot through with medical terms, as though they had been on the job for years. In fact, Mr. Dorf in the Claims Service consistently had been surpassing his job requirements by 40 percent.

Verdict of their new supervisors: "They're doing fine. In almost no time, they're among our best." Because of VA's efforts in employing the blind as well as other handicapped workers, the agency recently received the "Employer of the Year" award from the Blinded Veterans Association.

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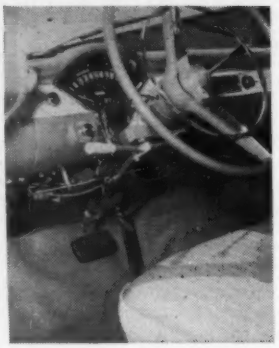

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VET ATTENDS COLLEGE BY TELEPHONE

Robert Mitchell of Long Island, N. Y., is attending college by telephone in an unusual experiment conducted by Veterans Administration. Mitchell, a former Air Force master sergeant, has never even seen the campus of C. W. Post College in Brookville, L. I., where he is enrolled as a freshman preparing for law school. Stricken by polio while in service, the 42-year-old veteran is confined to a wheelchair, with arms and legs paralyzed. He considers it a blessing that he can barely move his fingers.

Since Mitchell cannot get about, VA agreed to finance special equipment to permit him to "attend" classes through a two-way telephone hook-up that works like an office inter-communication system. From his specially-built "wheelchair home" in Glen Cove, L. I., the hook-up connects him with classrooms six miles away.

He takes six courses in three of the school's classrooms equipped with the telephone hook-up. From his custom-built desk equipped with an overhead transmitter and loudspeaker, he can listen to lectures and take part in classroom discussions, the same as any student. Although only his voice comes into the classroom, Mitchell has become a definite personality to his classmates and instructors. "We don't think of Bob as a voice booming out of a loudspeaker," one of his professors said. "He's a specific personality, a fellow classmate. And he's a fine student."

Instruction by telephone has been tried out privately before, but this is the first known instance of VA participation. VA rehabilitation officials in Washington are keeping close watch on Mitchell's progress—so far he's been getting a string of A's and B's for his courses—to see how well training by telephone works out. The opportunity may be extended to other seriously disabled home-bound veterans in other cities where two-way telephone hook-ups are possible.

Mitchell's home in Glen Cove, where he lives with his wife and two daughters, was especially constructed to meet his needs. It is fitted with a driveway and ramps, extra-wide doors, an automatic electric bed which turns him over during the night and a hydraulic lift that puts him in his chair. He received a $10,000 grant from the VA to build his home. Since moving in, he has obtained a ham radio operator's license and, with the help of other "hams," has a well-equipped amateur station.

Mitchell contracted polio while serving with the Air Force in Newfoundland in 1952. For five months he breathed through a tube in his throat. Long hospitalization and physical therapy followed at the VA hospital in Brooklyn, N. Y.

What about the future?

Mitchell believes there's plenty of room in the law profession for a quadriplegic. "About 90 percent of law work doesn't require courtroom appearances," he explained. "There's insurance, contract and closing procedures and the like. To make the grade, I know I have to do a little better than the next fellow, so I've buckled down to studying harder than I ever did before I got polio."

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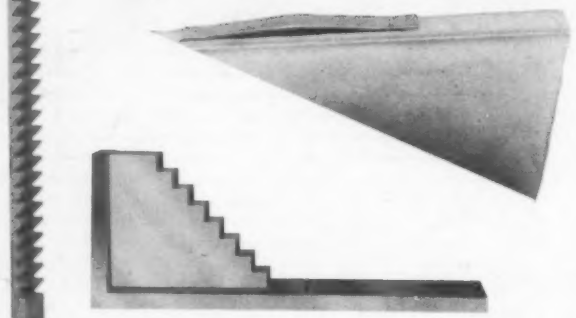

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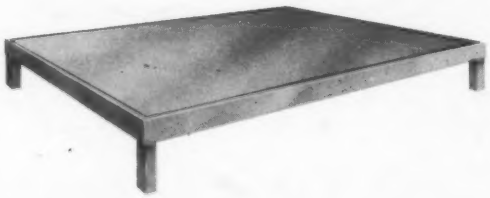

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